

SMART CAMPUS SOLUTIONS: VOICE-DRIVEN DIGITAL NOTICE BOARD FOR REAL-TIME INFORMATION DELIVERY

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering degree in Computer Science and Engineering

By

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

CATEGORY-1 UNIVERSITY BY UGC

Accredited with Grade "A++" by NAAC | 12B Status by UGC | Approved by AICTE

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **PRANTIK KARMAKAR** (Reg no - 40110983) and **SHREYA JEROME** (Reg no - 40111209) who carried out the project entitled "**Smart Campus Solutions: Voice-Driven Digital Notice Board for Real-time Information Delivery**" under my supervision from November 2023 to April 2024.

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I, Prantik Karmakar (Reg no - 40110983), hereby declare that the Project Report entitled **“Smart Campus Solutions: Voice-Driven Digital Notice Board for Real-time Information Delivery”** done by me under the guidance of **Dr. Saranya S. M.Tech., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.

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ABSTRACT

The recent developments made in the field of technology have led to the digitization of all the major platforms be it newsletters, newspapers, the knowledge-rich libraries, all these platforms have been digitized in some way or another.

One of the major ways to disseminate information in the past was the use of notice boards. A notice board, also known as a bulletin board or message board, serves several significant purposes in various settings, such as schools, offices, community centers, and public places.

Notice boards are a means of communication that allow individuals or organizations to share information, announcements, and updates with a wide audience. This can include news, events, notices, important dates, and other relevant information.

Notice boards are an efficient way to disseminate information to a large group of people without the need for direct, individual communication. This makes them valuable for reaching a broad audience quickly.

In schools and offices, notice boards help organize and structure information. For example, they can be used to display class schedules, meeting agendas, project timelines, or departmental updates in an organized manner. Notice boards can serve as reminders for important dates, deadlines, and events.

Overall, the significance of a notice board lies in its ability to facilitate communication, organize information, and engage various audiences in different settings. Whether for practical or promotional purposes, notice boards play a vital role in keeping people informed and connected.

Over recent years, the number of people who use notice boards has dwindled significantly, due to rapid developments being made in the smartphone industry and the Internet. People have started to steer clear of the past methods of content viewing and sharing and have adopted the much more convenient, interactive methods due to the digitization that has been brought about.

Traditional methods of notice board communication often fall short in terms of real-time updates and accessibility. This project proposes the design and implementation of a Voice-Driven Digital Notice Board to address these limitations.

The digital notice board integrates digital display technology with a voice assistant interface to provide a dynamic platform for disseminating information. Through this system, users can access notices, announcements, schedules, and important updates in an efficient and interactive manner. The voice assistant component enables users to interact with the notice board using natural language commands, thereby enhancing accessibility for individuals with diverse needs and abilities.

The project encompasses the design, development, and testing phases, with a focus on usability, functionality, and scalability. Evaluation of the digital notice board will involve user feedback sessions and performance analysis to assess its effectiveness in facilitating communication and improving information dissemination within various settings.

Overall, the proposed Voice-Driven Digital Notice Board presents a novel approach to modernize traditional communication methods, offering an intuitive and accessible solution for efficient information sharing in diverse environments.

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LIST OF ABBREVIATIONS

ABBREVIATION	FULL FORM
AI	Artificial Intelligence
API	Application Programming Interface
ASR	Automatic Speech Recognition
DLM	Domain Language Model
DOM	Document Object Model
GSM	Global System for Mobile Communications
HDMI	High-Definition Multimedia Interface
HTML	Hyper Text Markup Language
IOT	Internet of Things
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LFD	Large Format Display
ML	Machine Learning
MVC	Model View Controller
NER	Named Entity Recognition
NLP	Natural Language Processing
SBC	Single-Board Computer
SLU	Spoken Language Understanding
SMS	Short Messaging System
STT	Speech-To-Text
TTS	Text-To-Speech
UI	User Interface
USB	Universal Serial Bus

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

Digital notice boards, often referred to as digital signage, offer numerous advantages over traditional printed notice boards and static displays. Here are some key advantages of using digital notice boards:

- **Dynamic Content:** Digital notice boards allow you to display dynamic and real-time content, such as news feeds, social media updates, and live data, keeping the information fresh and engaging.
- **Flexibility:** You can easily update and change content remotely, making it simple to keep information current without the need for physical updates or reprints.
- **Cost-Efficiency:** While there is an initial investment in the hardware and software, digital notice boards can be more cost-effective in the long run compared to printing and distributing physical notices.
- **Eye-Catching Visuals:** Digital signage can use multimedia elements, such as videos, animations, and interactive content, to capture attention and convey messages more effectively.
- **Personalization:** Messages and content can be customized for specific audiences, times of day, or locations, allowing for targeted communication.
- **Remote Management:** You can control and manage multiple digital notice boards from a central location, making it easier to maintain consistency and control over content.
- **Timely Updates:** In emergency situations or urgent announcements, you can quickly update the content and reach your audience in real-time.

- **Environmental Benefits:** Digital signage reduces paper waste and the environmental impact associated with printing and disposing of physical materials.
- **Interactivity:** Some digital notice boards can offer interactive features, enabling users to engage with the content, such as touchscreens for wayfinding or product information.
- **Analytics and Feedback:** You can gather data on how often content is viewed and for how long, providing insights into audience engagement. You can also receive feedback through interactive elements.
- **Centralized Control:** Digital notice boards can be part of a network, allowing for consistent branding and content across multiple locations or departments.
- **Promotion and Marketing:** In a commercial setting, digital notice boards can be used to promote products, services, and special offers effectively.
- **Scalability:** Digital signage solutions can easily scale to meet the needs of your organization or project. You can add more displays as required.
- **Scheduling:** Content can be scheduled to appear at specific times or on specific days, ensuring that relevant information is displayed when needed.
- **Content Variety:** Beyond announcements and text, digital notice boards can display a wide variety of content, including images, weather updates, event listings, and more.
- **Reduced Labor Costs:** Digital notice boards can reduce the need for manual labor associated with updating and maintaining traditional notice boards.
- **Remote Accessibility:** You can manage and update content remotely, making it convenient for administrators or content creators.

- **Integration with Data Sources:** Digital notice boards can be integrated with databases, APIs, and other data sources to display real-time information, such as stock prices, weather data, or public transport schedules.

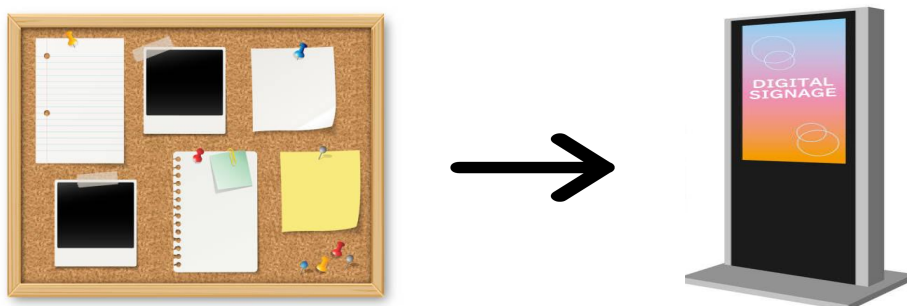
Overall, digital notice boards offer enhanced communication capabilities and the ability to deliver information more effectively, making them a valuable tool in various settings, including educational institutions, corporate offices, public spaces, retail stores, and more.

1.2 PROBLEM STATEMENT

The traditional method of manually maintaining notice boards is quite tedious and labor-intensive as it involves printing the documents on paper, navigating to where the notice board is physically present and pinning them up in an organized manner.

This procedure must be done systematically and in a timely manner whenever the need arises to put up a new notice. It is a hassle to maintain the notice board properly in this manner and also involves a lot of human effort when several notice boards are to be maintained simultaneously all throughout the organization / educational institution.

Here, we put forth the concept of digital notice boards based on Internet of Things (IOT), that makes it much easier to maintain notice boards systematically, and provides the facility to manage them remotely as well.



1.1 Conversion from traditional to digital notice board system

The objective of this project is to create a digital notice board that makes viewers aware of events, notices, and announcements. It will serve as a site where individuals can disseminate information and publish notices, put up event posters to announce upcoming events, and display descriptions associated with them.

Nowadays, the implementation of voice commands / voice assistants is prevalent as it makes many day to day functionalities much easier to perform. Therefore we have enhanced the pre existing system by including the implementation of voice commands.

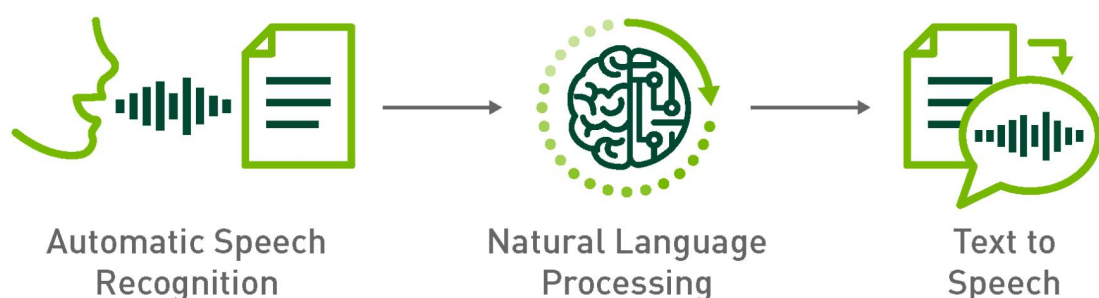
We have included a set of basic commands that can be identified and responded to accordingly by the system through the speech recognition module. The voice commands are an added functionality that enhances the user experience and makes the system easy to use and interactive. It also allows the user to have a hands-free experience with the system.

The microcontroller is used to control the display to view the information that is on the web platform, process the voice commands from the speech-recognition module. The microcontroller acts as a mini-computer and is the control unit of the system. It helps the system connect to the internet, thereby allowing for remote communication and other capabilities.

1.3 OBJECTIVES AND SCOPE

- To create a web platform (a web application), which will be used to upload the content to be displayed and to display those contents on the digital notice board. Providing administrators with a web-based interface would enable them to easily create, update, and manage notices displayed on the digital notice board, streamlining the notice management process.
- Design an intuitive user interface for both the digital notice board and the web interface, ensuring ease of navigation and interaction for both administrators and users.

- To include an admin login to facilitate authorized ability to upload the notices to be displayed on the board.
- The notice board must be interactive and easy to use. Should display the required information accurately.
- To facilitate real-time synchronization between the web interface and the digital notice board, ensuring that notices are promptly updated and displayed to users as changes occur.
- Design the system to be scalable and flexible, capable of accommodating future enhancements, additional features, and integration with other technologies or platforms.
- Utilize Wi-Fi communication to establish reliable and stable connectivity between the web interface, Alan AI's voice command processing service, and the digital notice board hardware.
- The implementation of a voice assistant using text- to- speech and speech- to- text capabilities; which enables the use of voice commands to interact with the notice board and makes the notice board convenient to use. It also enhances accessibility for individuals with diverse needs and abilities.



1.2 Speech to Text and Text to speech using NLP

- To ensure seamless integration of Alan AI's voice command functionality, the web interface, and the digital notice board hardware, providing a cohesive and unified user experience.

The scope of this study encompasses a comprehensive examination of the implementation and impact of digital signage within our notice board system, juxtaposed against pre-existing traditional media methods. This includes an in-depth analysis of various aspects such as content delivery, accessibility, user engagement, and cost-effectiveness. Additionally, the study will explore the technical feasibility and logistical considerations associated with transitioning from traditional media to digital signage, including hardware requirements, software integration, and maintenance protocols. Furthermore, the scope extends to evaluating user perceptions, preferences, and satisfaction levels with both communication methods, providing valuable insights into the effectiveness and acceptance of digital signage as a modern communication tool. By elucidating the comparative advantages and limitations of each approach, the study aims to inform strategic decision-making and facilitate the adoption of innovative communication technologies within our organization.

CHAPTER 2

LITERATURE SURVEY

2.1 OVERVIEW OF EXISTING RESEARCH AND LITERATURE

“A Novel Method of IoT Based Smart Notice Board Using Raspberry PI” authored by Venkatesh Kumar S, Amirthasri S, Ananya M, Esther S [1] discusses an SMS based notice board using Raspberry Pi to make it easier for a user to display messages on a notice board using their phone. The main advantage of this device will be a Raspberry pi card for receiving commands from web servers on mobile phones or pc. This device is a wireless notice board that shows the user’s message and was created to be an easy-to-use system that can receive and display notice in a specific way.

“Smart Digital Notice Board” authored by Asmita M.Khairnar, Rashmi K.Kolambe, Prof.S.S.Vaidya discusses how to create a remote notice board that can present the information in the form of images.[4] For the processor, it makes use of a Raspberry Pi. The Raspberry Pi has a portable projector and LCD display. The system will transmit the notice sent to the cloud. It then navigates to the notification board, which is connected to the internet through Wi-Fi. It processes it and displays the results on the screen.

“IoT Based Smart Notice Board” authored by Y. Sravana kumar, D. Hima Varshini, D. Tilothama, D.Jagadeesh, I. Jithendra [5] discusses the development of an automatic, self-enabled and highly reliable electronic notice board using Arduino UNO. A display connected with the cloud will wait for the message from the user, if the user uploads the data through the server, it will automatically upload to the LED. The user can upload the message to the LED by accessing through the website connected to the server. The user can write the data from anywhere in the world to the LED.

“IOT Based Digital Notice Board” authored by Trupti Pabale, Shweta Borade, Bhagyashri Deore, Mohani Kharwar, and Deepika Thakare [6] describes an IOT based digital notice board that utilizes Raspberry PI microcontroller and an android

app to send the messages to the board. It enables remote control of the system.

“Wireless Digital Notice Board Using IOT” authored by M. Phani Sridhar, Sk Ayesha, Tarun Dev and Varanasi Sai Aseesh discusses [7] a wireless notice board system which utilizes IOT technology and uses the IP address of the notice boards to transmit information to it accurately.

“IOT based Digital Notice Board” authored by Rhutik Dhanawade, Abhishek Sasne, Vishal Patole, Bhawana Patil, Ajinkya Patil discusses a model which enables the authorized admin to post the message from anywhere and this message can be portrayed on the LED Display.[8] It involves the development of a digital notice board that display message sent from the user through mobile phone (SMS) and to design a simple, user friendly system, which can receive and display message/information in a particular manner with respect to date and time which will help the user to easily keep the track of notice board every day and each time he uses the system.

“IOT based Smart Notice Board” authored by Gaurav Bhardwaj, Gunjan Sahu, Rajan Kumar Mishra [9], describe a model where the main function of the proposed system is to develop a Digital notice board that displays the message sent from the user through mobile phone (SMS). The system consists of two sections, sender and receiver. Sender is responsible for sending valuable information through the GSM protocol. In order to access the Digital notice board the sender must enter the corresponding mobile number. When the user enters the correct mobile number, the message can be typed and get space for the information transmission. An android application is developed using which the sender can directly enter their message. In the receiver section, the PIC microcontroller is connected to a GSM module for accessing the sim card.

“Wireless Electronics Notice Board” authored by Unmesh Mawalkar, Snehal Sardar, Harshada Varade, and Prof. M. P.Giri discusses the development of an IOT based electronic notice board using IP based infrastructure. It uses an ATmeg328 microcontroller and an LED matrix panel display [10] to show the messages.

“Conversational Voice Controlled React News Application Using Alan AI”

authored by Vinay Sahu, Pallavi Ubnare, Priyanshu Patil, Priya Barhaiya, Shreyash Sinha, and Rohit Dafare [16] utilizes React for developing the user interface of the news application, and Alan AI that enables the system to be voice controlled.

“Voice Controlled News Web Based Application With Speech Recognition Using Alan A.I.”

authored by Aditya Sharma, Subiya Siddiqui, Sugandha Trivedi, Ali Murtaza, Mohd Faiez, Shyam Dwivedi [17] proposes the idea of speech recognition system which provides news only with the help of user command through voice with very detailed or concise manner according to user's choice. The user can access news by category, popular news channel, by terms etc. The web app is completely responsive in mobile phones, tablets, laptops and desktop. The project is developing using reactJS, JavaScript, Visual Studio Code, and Alan AI.

“Design and Development of a Smart Mirror Based On IOT”

authored by Bharath M, et. al. proposes a smart mirror setup that can display updates, weather details, date and time etc. and can also act as a basic personal assistant with functionality similar to that of Siri or Alexa.[11] The system has been built using Raspberry PI and a two way mirror that doubles as a display when the monitor placed behind the mirror is switched on.

“Bluetooth Based Electronic Notice Board”

authored by Ashutosh Pandya, Chinmay Raut, Mihir Patel, Siddharth Das, Amol Deshpande discusses a wireless notice board display system that uses a liquid crystal display screen to show the latest notices which are communicated to it via an android application. GSM Module [12] is used to send the data to be displayed to the board.

“Remotely Controlled Electronic Noticeboard Using NodeMCU”

authored by A. Kumar, G. Singh, V. Rawat, D. Negi and A. Joshi describes the construction of a simple notice board system to relay messages in a simple text format to the viewers of the board. The system makes use of a web page to control the messages being displayed. The system is implemented using the NodeMCU ESP8266 microcontroller and an 8x8 matrix led display [13] for message viewing.

“Why Do People Use Artificial Intelligence (AI)-Enabled Voice Assistants?”

authored by S. Malodia, N. Islam, P. Kaur and A. Dhir highlights the growth and appeal of voice assistants in present day technological applications.[14] This study mainly focuses on the theory of consumption values and consumer trends of different voice assistants and their impact on their usage in different use case scenarios.

“Bluetooth Based Digital Notice Board With Solar.” authored by Karlekar, Gaurav S., Prachi V. Dhamange, Pallavi S. Duratkar, Shrushti S. Vaidya, Ankita R. Zilpe, and Simran S. Gujar [15] describes the way to modernize the traditional approach of using notice boards by harnessing wireless technologies like Bluetooth and discusses using Solar as a potential alternative to power the system.

2.2 INFERENCES FROM LITERATURE SURVEY

Notice boards are a traditional yet effective tool for communication and information dissemination. Here’s an analysis of their use nowadays both in traditional set-ups as well as in existing digital systems as observed through our survey:

- **Conveying Information:** Notice boards are used to announce news, display work results, advertise upcoming events, and communicate important notices. They can also be used to display student artwork in schools or support local businesses.
- **Improving Communication:** Notice boards can improve communication amongst co-workers. They can create a sense of unity and help staff be more productive.
- **Building Identity:** Notice boards can help build a company’s identity. They can act as a bulletin board for new work updates.
- **Ease of Use:** Notice boards are easy to use. It’s simple to add and remove notices when necessary. Mobile notice boards can be moved around easily, making them ideal for conference rooms.
- **Organization:** The key to effective content display is to keep it organized. Removing items when they are no longer needed ensures new literature is viewed by everyone.

- **Security:** Notice boards can come lockable or non-lockable. If you want to avoid people tampering with the information on display, secured, lockable notice boards are great.

In conclusion, despite the rise of digital communication tools, notice boards continue to play a crucial role in facilitating effective communication in various settings. They offer a simple, accessible, and tangible way to share information, making them relevant even in today's digital age.

In a majority of the previously existing smart notice board models, the use of GSM has been observed in order to send the message to be displayed on the board.

Several implementations include development of an android application to control the contents of the notice board. However creation of a website will make it easier to access on multiple platforms and devices.

Implementation of voice commands to interact with the notice board is relatively novel and would make the experience much more convenient and interactive.

2.3 OPEN PROBLEMS IN EXISTING SYSTEM

- **Static Interfaces:** Existing systems have static notice boards and user interactivity is limited. The displays are too bland and the users may lose appeal after a certain point of time, keeping the user engaged is of paramount importance.

Static notice boards do not actively engage viewers. People may simply glance at the information without interacting with it, leading to reduced attention and retention of the displayed content.

Without interactivity, you can only present a fixed amount of information on the notice board. This limitation can be problematic when you have a lot of information to convey.

- **Display:** Several existing systems make use of low resolution of simple small scale LED/LCD displays, which limit the amount of information that can be viewed at once, effectively making it more of a message displayer than a notice board that can be utilized to the benefit of several users.

As a result of low resolution, text and images may appear unclear and difficult to read, especially when displaying detailed or small fonts. Small text and fine details may be challenging to read on a low-resolution display, particularly from a distance. This can be a problem in situations where viewers are not in close proximity to the screen.

This can hinder the effectiveness of the notice board in conveying information. Low-resolution displays lack the clarity and sharpness of high-resolution screens, leading to pixelation and blurry text and graphics.

- **Notice format:** In pre existing systems notices were often limited to being displayed in the text message format alone. Text-only displays can be less visually appealing and may not capture the attention of viewers as effectively as a combination of text and images. This can result in reduced engagement with the notice board.

Displaying notices in the form of images are not supported by those systems. Images and graphics can often convey information more quickly and effectively than text alone. Images make it easier to comprehend large amounts of information at a glance and are very essential for the provision of an easy-to-understand spread of info to be served to the user to make them aware of upcoming events, notices or announcements.

Without images, you may need to use more text to convey the same information, potentially overwhelming viewers with lengthy content. A text-only notice board may struggle to stand out and attract viewers' attention.

- **Android Application vs Web app:** Utilizing an Android application to display the content would limit the ability to manage it from anywhere using any device. An application would require users to download and install the mobile app on their devices, which can be an additional step.

Mobile apps are designed for specific operating systems (e.g., iOS and Android), which can limit the number of devices that can control the notice board. Users must have compatible smartphones or tablets to access the app. An android app to control the notice board would not be available on iOS devices, thereby limiting accessibility.

Developing separate apps for iOS and Android can be more time-consuming and costly than creating a single web app that works on various devices and operating systems.

- **Use of Arduino UNO:** The previous systems made use of the Arduino UNO board which is a microcontroller board as opposed to Raspberry Pi which is a fully fledged microcomputer with a processor, memory, and operating system. Arduino UNO has a much lesser processing speed (16 MHz) while Raspberry Pi clocks much better processing speeds (up to 1.6 GHz) (depending on the board).

Raspberry Pi has built-in networking capabilities, including Ethernet and Wi-Fi (depending on the model). It can easily connect to the internet and communicate with other devices on a network, making it ideal for IoT (Internet of Things) applications.

Raspberry Pi supports graphics and HDMI output, which makes it suitable for applications that require display and graphical user interfaces. It can be used for media centers, digital signage, and more. These are essential features for a high quality interactive system, which are not found in Arduino UNO.

- **Drawbacks of GSM:**

Several pre-existing systems make use of GSM to transmit the messages and notices to be displayed on the notice board to it. The multiple drawbacks of utilizing GSM as opposed to WiFi have been highlighted as follows:

Connectivity: Previous systems that used GSM were solely dependent on the GSM connectivity which is affected by factors such as network coverage, signal availability and other interferences. GSM relies on cellular networks, and its availability can be limited in some areas, especially in remote or poorly covered locations. This can result in inconsistent access to notice board content. Network outages or poor reception can disrupt access to the content.

Speed: GSM is slower as compared to data transfer across Wi-Fi. We will be utilizing the feature of Raspberry PI to support Wi-Fi connectivity with the display. This will make the system performance faster.

GSM connections tend to have slower data transfer rates compared to broadband

internet. This can lead to delays in updating and accessing content on the notice board, particularly when dealing with large files or images.

Cost: GSM connections may incur data charges, which can be costly, especially if the notice board content is updated frequently or if the display includes multimedia elements like images or videos.

Security: The GSM protocols suffer from many weaknesses which allow for the development of several attacks, such as eavesdropping or unauthorized access, able to break confidentiality and privacy of subscribers.

GSM connections are more susceptible to security risks, compared to internet connections that use encryption and secure protocols.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

3.1.1 Monetary Feasibility and Risk:

Monetary feasibility is a critical aspect of assessing the viability and success of a technology project. It determines whether a project can be completed within the available budget by assessing budget constraints, managing financial risks, and making well-informed decisions throughout the project's lifecycle.

- ***Financial Feasibility:***

Cost Estimation: Determine the estimated project cost, including expenses for hardware, software, labor, and other resources. Calculate the costs associated with hardware, software development, voice recognition software, and ongoing maintenance.

Budget Constraints: Assess whether the project falls within your budget or the allocated funds.

- ***Financial Risks:***

Cost Overruns: The project might exceed the budget due to unexpected expenses or delays. Thus it is necessary to monitor and control project expenditures to prevent cost overruns. Financial risks associated with the project must be identified, such as unexpected cost increases or revenue shortfalls.

Develop contingency plans and risk mitigation strategies to address potential financial challenges.

Market Fluctuations: Economic or market changes may affect the availability and

cost of hardware components.

3.1.2 Technical Feasibility and Risk:

Technical feasibility is a critical factor in the evaluation and planning of a technology project. Technical feasibility plays a crucial role in ensuring that a project is viable from a technical perspective, given the available resources, technology, and expertise.

It involves assessing technology readiness, resource availability, potential risks, and the ability to integrate with existing systems. A comprehensive technical feasibility analysis is essential for making informed decisions and for planning its successful implementation.

- ***Technical Feasibility:***

Resource Availability: Determine whether the required technology and infrastructure are available or can be developed to support the project's goals. Evaluate the availability of hardware, software, and other technical resources needed for the project.

Infrastructure and Network assessment: Evaluate the state of the existing infrastructure and network to determine if they can support the project's technical demands.

Hardware Evaluation: Assess the technical capabilities of Raspberry Pi for your specific requirements, including its processing power, memory, and connectivity options.

Prototyping and Testing: Build prototypes or conduct technical testing to validate the feasibility of the proposed solution. Use the technical feasibility analysis to make informed decisions about whether the project is technically viable, and if so, the best approach to take.

Voice Recognition: Evaluate the feasibility of implementing voice command recognition on the Raspberry Pi.

Compatibility: Ensure compatibility between Raspberry Pi and the React.js web platform for content control

- ***Technical Risks:***

Assessing Technical risks: Identify technical risks and challenges that may arise during the project's execution. Develop strategies to mitigate or address these risks effectively.

Hardware Limitations: Raspberry Pi may have limitations in terms of processing power and memory, potentially affecting performance.

Voice Recognition Accuracy: Voice recognition technology may have limitations, leading to issues with command recognition.

Compatibility Issues: Compatibility issues between Raspberry Pi and React.js or other components could arise.

3.1.3 Operational Feasibility and Risk:

Operational feasibility is an important aspect of evaluating the viability and success of a technology project. It focuses on whether the project can be implemented and integrated into the organization's existing operations and processes in a practical, effective and efficient manner.

It involves assessing alignment with existing processes, resource availability and the ability to meet operational objectives. A comprehensive operational feasibility analysis is crucial for making informed decisions about the project's viability and for successful implementation.

- ***Operational Feasibility:***

Alignment with existing operations: Evaluate whether the project aligns with the organization's existing processes and objectives. Assess if the project

complements or disrupts current operations. Determine how the project will fit into existing workflows and procedures. Evaluate the potential impact on day-to-day operations and make adjustments as necessary. Assess the readiness of the organization and its employees to adapt to new processes and technologies.

Usage analysis: Identify the end users, such as the target audience for the notice board. Evaluate the ease of use of the voice commands and web platform for content control.

Decision Making: Create a feasibility report and use the operational feasibility analysis to make informed decisions about whether to proceed with the project, considering its impact on operations

- ***Operational Risks:***

Risk Management: Identify operational risks and develop strategies to mitigate these risks. Consider the impact of any operational disruptions on the organization.

User Acceptance: End users may have difficulties with voice commands, or they may prefer traditional interfaces.

Technical Support: Consider the availability of technical support for Raspberry Pi and React.js.

3.1.4 Schedule Feasibility:

Define project timelines and milestones to determine whether the project can be completed within the desired timeframe. Delays in software development can impact the project schedule.

3.1.5 Dependency Risks:

Dependencies on third-party services, such as voice recognition APIs, can introduce risks related to service availability and changes in their terms.

It's important to thoroughly analyze each of these areas to assess the feasibility and potential risks associated with our digital notice board project. Mitigation strategies should also be developed for identified risks to minimize their impact on the project's success. Additionally, we must conduct a pilot or prototype phase to validate the feasibility and gather user feedback before a full-scale deployment.

3.2 SOFTWARE REQUIREMENTS:

- **REACT** - ReactJS is an open-source JavaScript library used to create user interfaces in a declarative and efficient way. It is a component-based front-end library responsible only for the view layer of a Model View Controller(MVC) architecture. React is used to create modular user interfaces and promotes the development of reusable UI components that display dynamic data. ReactJS will be utilized to build the web platform for displaying the latest notices.
- **ALAN AI** - Alan AI allows you to add a multimodal conversational experience to your app without overhead. Alan AI is an end-to-end conversational AI platform to build robust and reliable AI assistants and chatbots. The Alan AI backend takes care of most of the heavy lifting, including creating spoken language models (SLU), training speech recognition software, deploying and hosting conversational components. To create a conversational experience, you only need one developer, not a group of Machine Learning and Dev Ops specialists.
- **NLP** - Natural language processing (NLP) is a subfield of Artificial Intelligence (AI). This is a widely used technology for personal assistants that are used in various business fields/areas. This technology works on the speech provided by the user, breaks it down for proper understanding and processes it accordingly.

3.3 HARDWARE REQUIREMENTS

- **RASPBERRY PI** - Raspberry Pi is a series of small single-board computers (SBCs) developed by the Raspberry Pi Foundation in association with Broadcom, targeting use in robotics initially. Now, it is widely used in many areas, such as for weather

monitoring, because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of the HDMI and USB standards. It has inbuilt Ethernet port and WiFi support.

- **DISPLAY UNIT** - It can be a LFD (Large Format Display) or any display with a HDMI port. This is the component that the user can see and interact with and the part of the system that facilitates the user experience, thus it is necessary to choose a display that is appropriate according to the requirements of the location where the system is set up and the number of viewers it is intended to cater to at any given time.
- **MICROPHONE** - To connect a microphone to a Raspberry Pi for speech recognition, you'll need to follow several steps. Here's a general guide on how to set up a microphone and enable voice commands:

1. Obtain the Required Hardware:

- USB or I2S (Inter-IC Sound) compatible microphone: You can use a USB microphone for simplicity or an I2S microphone for higher audio quality.
- Raspberry Pi with Raspbian OS installed.

2. Connect the Microphone:

- For a USB microphone, simply plug it into one of the available USB ports on your Raspberry Pi.
- For an I2S microphone, you will need to connect it to the GPIO pins on your Raspberry Pi. The specific pin connections will depend on the microphone model you choose. Consult the microphone's datasheet or manufacturer's instructions for pin configurations.

3. Enable and Test the Microphone:

- For a USB microphone, it should be automatically recognized by Raspbian.
- For an I2S microphone, you may need to enable the I2S interface on your Raspberry Pi. You can do this through the Raspberry Pi Configuration settings, and you may need to modify your config.txt file to configure the I2S interface.

CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

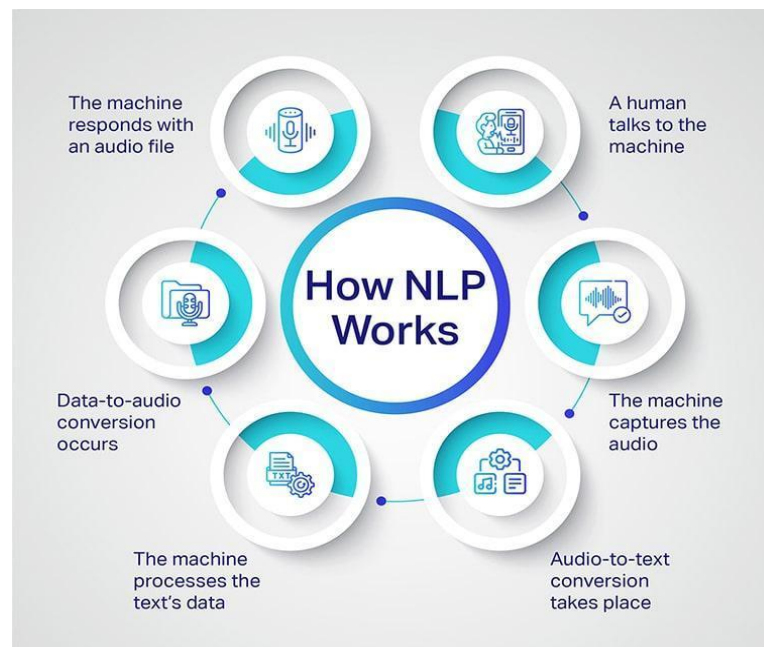
4.1 SELECTED METHODOLOGY OR PROCESS MODEL

- **VOICE COMMANDS TO INTERACT WITH THE NOTICE BOARD -**

The notice board system takes in instructions from the user in the form of voice commands via the microphone connected to the Raspberry Pi (Microcontroller). Some examples of commands that can be implemented include “show events”, “show announcements”, “scroll up”, “scroll down” etc.

- **PROCESSING THE VOICE COMMANDS -**

The voice processing is performed in the Alan AI Cloud. The Alan AI Cloud is the AI-backend of the Alan AI Platform. This is where dialog scripts are hosted and Spoken Language Understanding (SLU) and Natural Language Processing (NLP) tasks are accomplished.



4.1. NLP Working

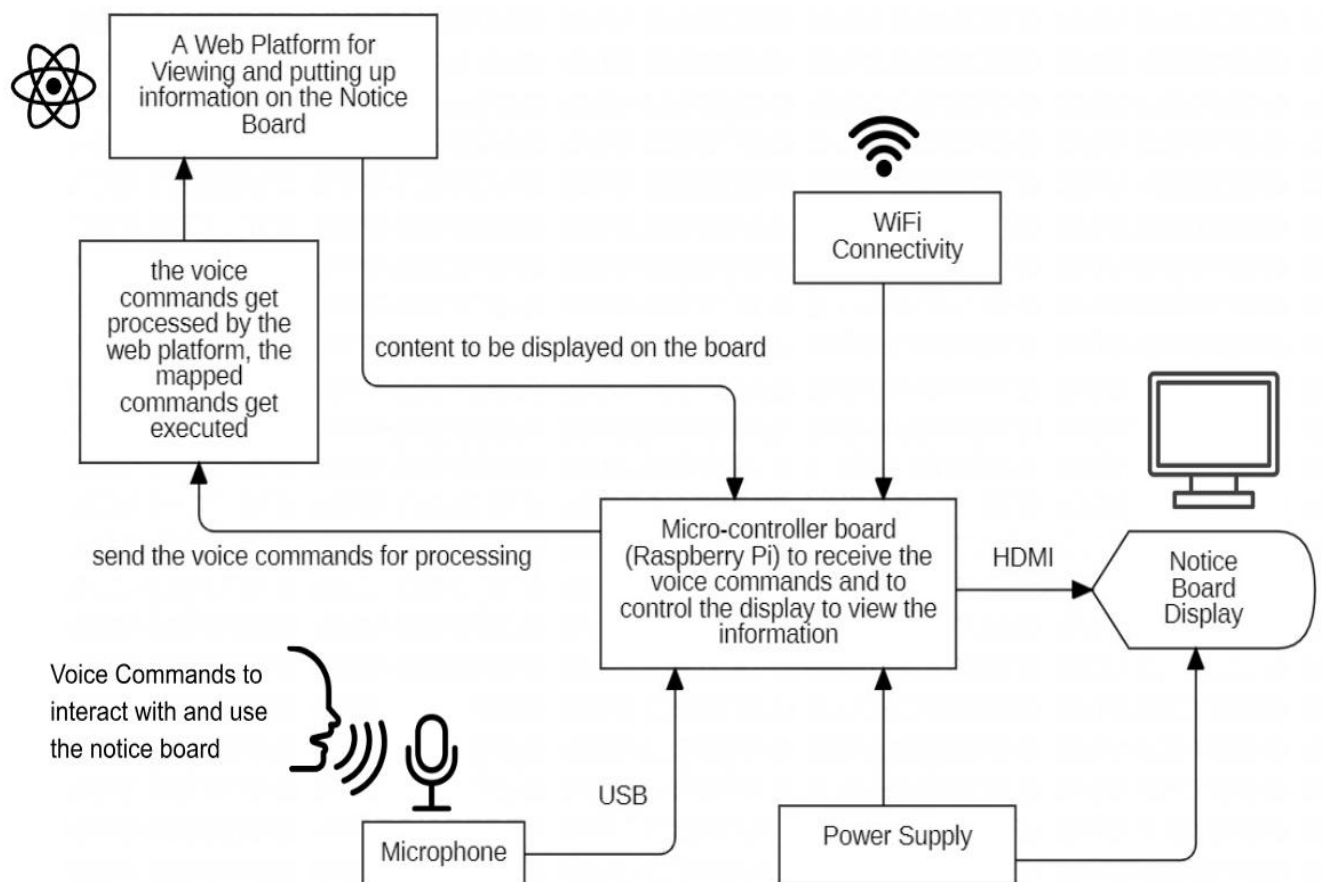
- **FETCHING THE CONTENT TO BE DISPLAYED -**

The commands are mapped to specific functions which help in navigating through the notice board system. Once the commands are processed and interpreted from the user's speech, the respective actions are taken according to the voice command received in order to give the desired output. Content is accessed from the web platform where all the notices and events are uploaded by the admin (authorized by admin login).

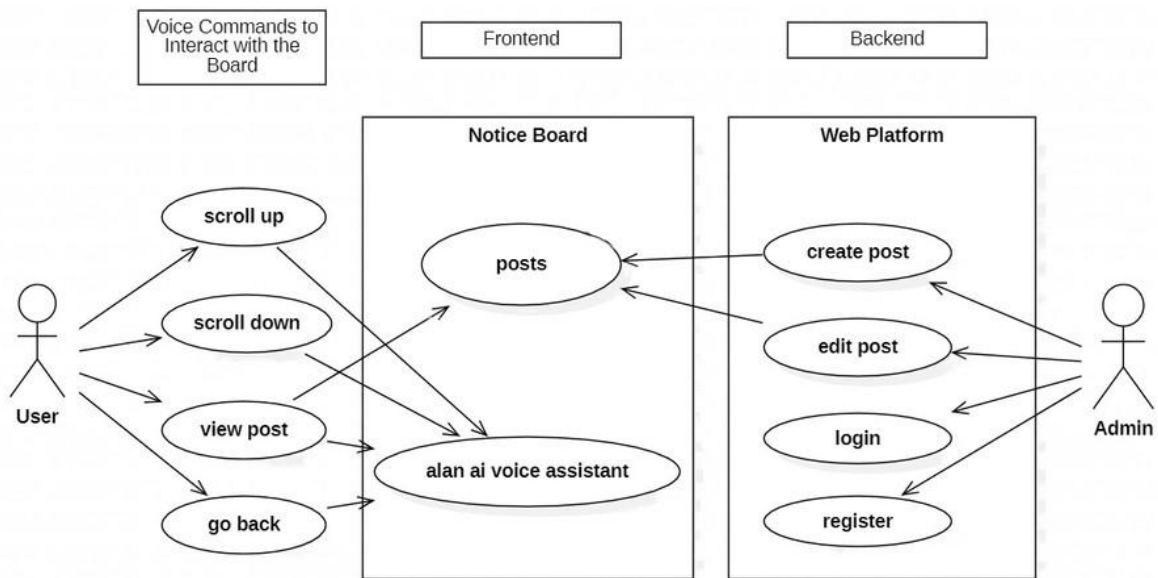
- **DISPLAYING CONTENT -**

Raspberry Pi connects the web platform and the notice board display over a wireless network. It enables the fetched content to be viewed on the display unit.

4.2 ARCHITECTURE / OVERALL DESIGN OF PROPOSED SYSTEM



4.2. System Architecture



4.3. System Use Case Diagram

As seen in the use case diagram, the user can use commands like “scroll up” and “scroll down” to view the posts on the page. The page displays the 20 most recent posts on the home page, with the most recently uploaded post on the topmost position. These commands help navigate and scroll through both the home page as well as the individual posts that the user would like to view.

The “view post” command can be used to select a particular post to view more details about it such as the date and time of the events, detailed description, registration links and contact numbers etc. The “go back” command helps navigate back to the homepage.

These voice commands can be used to interact with the notice board, and each command from the user triggers an acknowledgement from the notice board, which responds with speech. This informs the user that the command has been successfully captured by the voice assistant.

On the admin side, we can create new credentials on the registration page, if the credentials already exist, then an alert message is triggered saying that registration is unsuccessful. However, if the registration is successfully completed,

then an alert message notifies the same, and we can now use these credentials to login to the page. All credentials are stored in the database and passwords are encrypted during storage so as to ensure privacy.

Creating a new post is possible only after login. On creation, the author name, upload date and time is displayed alongside the post. Editing a post is possible only if you are the author of said post. Admins do not have access to edit posts that have been uploaded by other admins. All created posts are stored in the database along with the description details.

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

- **React:**

React.js, often simply referred to as React, is an open-source JavaScript library developed and maintained by Facebook. It is a powerful and popular library for building user interfaces (UIs) for web applications. React is known for its declarative and component-based approach to building interactive and dynamic web interfaces.

Declarative and Component-Based:

React is a declarative library, which means you describe the desired outcome, and React takes care of updating the DOM to match that description. It encourages developers to break down the UI into small, reusable components. Each component represents a part of the user interface and can be composed to create complex applications.

Virtual DOM (Document Object Model):

React uses a Virtual DOM to improve the efficiency of updating the actual DOM. Instead of making direct changes to the DOM, React creates a virtual representation of it. When changes occur, React compares the new virtual DOM with the previous one and calculates the most efficient way to update the actual DOM, minimizing browser reflows and repaints for improved performance.

One-Way Data Flow:

React enforces a unidirectional data flow, making it easier to understand how data changes in your application. Data flows from parent components down to child

components, and when changes are needed, they're typically handled through callbacks or events. This helps prevent unexpected side effects and makes it easier to debug and reason about your application's behavior.

JSX (Javascript XML):

React introduces JSX, an extension to JavaScript that allows you to write HTML-like code within your JavaScript files. JSX makes it more intuitive to define the structure of your UI components. Under the hood, JSX is transpiled into regular JavaScript code by build tools like Babel.

Reusable Components:

React promotes the creation of reusable UI components. You can create a component once and use it throughout your application. This reusability improves maintainability and helps ensure consistency in your UI.

State Management:

React allows components to manage their own internal state. State is used to store data that can change over time, such as user interactions or data fetched from a server. When the state changes, React automatically re-renders the component to reflect those changes.

The proposed system uses ReactJS to build the web platform. It helps build the functional front end of the website that the user interacts with. React is used to create modular user interfaces and it also involves the development of reusable UI components. ReactJS will be utilized to build the web platform for displaying the latest notices.

The web platform displays the notices in a format that involves a combination of both images and text. The notice format involves an image alongside a short description for the same, the author and the date and time the notice has been posted. The home page displays 20 of the most recently uploaded notices at a time. More detailed information on the same are available within each notice.

Registration allows us to create new admin login credentials, and logging in

enables us to create new notices, or to edit pre-existing notices provided we are the authors of said notice.

All the created login credentials are stored in the database and the passwords are encrypted for safety. All the uploaded notices are also stored in the database.

This web platform is used both to manage the content of the notice board as well as to display that content on the screen.

- **Alan AI for Voice Processing:**

Alan AI seamlessly integrates with your application's existing features and functionalities, providing users with a unified and cohesive user experience. Users can access the voice assistant directly from the application interface, enabling effortless interaction.

Alan AI is compatible with various platforms, including mobile apps (iOS, Android), web applications, and other digital environments, ensuring consistent accessibility across devices and environments.

Under the hood, the Alan AI Cloud engages a combination of voice AI tools and technologies to simulate human-like dialog between the user and the app. Together, they allow Alan AI to interpret human speech, generate responses and perform the necessary actions in the app. The main voice technologies used by Alan AI are:

- Natural language processing (NLP)
- Spoken Language Understanding (SLU)
- Automatic Speech Recognition (ASR)
- Machine Learning (ML)

- Speech-to-Text (STT) and Text-to-Speech (TTS)

Leveraging state-of-the-art natural language processing (NLP) algorithms, Alan AI accurately interprets user commands and queries, enabling fluid and conversational interactions.

How voice processing works

Alan AI's main goal is to match what the user says to a specific voice command in the script. To do this, Alan AI needs to rearrange unstructured data in the user's input so that it can be analyzed and processed at the machine level.

Voice commands processing starts on the client side. The Alan AI SDK captures the voice stream from the user's device and sends the voice data to the Alan AI Cloud for processing.

Alan AI uses the Automatic Speech Recognition (ASR) engine and Speech-to-Text (STT) to get the user input and convert it to text segments.

With the help of Spoken Language Understanding (SLU) and Named Entity Recognition (NER) systems, Alan AI evaluates the phrase patterns, draws the intent and meaningful words, such as location, date and time, from the phrase.

For high accuracy of matching, Alan AI uses the Domain Language Model for your app.

Alan AI matches the phrase to a user's command in the dialog script. This is where Alan AI's Machine Learning (ML) algorithms are leveraged. Each phrase is given a probability score, with '1' being the most accurate match.

If the AI assistant is supposed to give a response, it uses the Text-to-Speech (TTS) technology to synthesize speech that sounds natural.

You can check the phrase probability score in Alan AI Studio logs. To do this, at the bottom of Alan AI Studio, open the logs pane and click the phrase given by the

user.

Alan AI's ASR and Domain Language Model:

During voice processing, the ASR engine converts speech to text. And one of the vital components in ASR is the language model. The language model evaluates probabilities of word sequences, which allows ASR to distinguish between words that sound similar.

Beside the global language model, Alan AI creates a domain language model (DLM) for every app. The DLM is based on unique terms, names and phrases used in your company or domain. It lets Alan AI's ASR predict with high accuracy what user may say in a particular context and resolve ambiguities.

To build a DLM, you do not need to provide a large dataset with variants of utterances or to create spoken language models. Alan AI automatically trains on small existing datasets and generates models with phrases and intents for your app. As a result, you get an AI assistant that deeply understands the UI, workflow and business logic of your app.

Another thing that can impact the accuracy of the ASR engine is noise. Alan AI uses its probabilistic approach to face this problem. It handles speech recognition errors and ensures the AI assistant works reliably in noisy environments.

Integrating Alan AI with React

We first installed the Alan AI webpack using the node package manager.

```
npm install @alan-ai/alan-sdk-web --save
```

We then proceed to import the `alanBtn` from the webpack installed and in the `useEffect` function. We make use of the `alanBtn` using our API key from the Alan AI SDK.

With the use of Alan AI we need not make our own voice assistant from scratch

and can use the various features in Alan AI Studio to make our voice assistant. We make use of intents to map the various voice commands to their specific functions.

Alan AI allows us to add conversational experience via robust and reliable AI assistants or chatbots to our application. The Alan AI backend takes care of most of the heavy lifting when it comes to speech processing. It is easy to integrate into and employ with react js web applications. The Alan AI button is visible at the bottom right corner of the screen, and it allows for the voice commands to be taken.

We have implemented the Alan AI voice assistant to our website, which is capable of taking voice commands and responding to them by performing the associated mapped functions.

Alan AI supports a wide range of voice commands across various use cases, including task management, information retrieval, navigation, entertainment, and more. Users can perform actions such as setting reminders, checking weather forecasts, searching for information, controlling smart home devices, and interacting with application features.

Using Alan AI, a feature that we have included in the voice assistant allows users to ask it for details on “how this notice board works” or “how to use this”, which prompts the assistant to detail what kind of commands are used in the system.

We have added voice commands like “scroll/go up”, “scroll/go down”, “go back” (to navigate back to the homepage of the web platform), and many more.

It also responds to each command given to it with a spoken acknowledgement to show that the command has been captured and comprehended by it. Powered by advanced text-to-speech technology, Alan AI delivers natural-sounding speech responses to user queries and commands. Its expressive voice and clear articulation ensure a pleasant and engaging user experience.

Alan AI employs robust error recognition mechanisms to detect errors and misunderstandings in user input. It provides clarification prompts and error messages to guide users and ensure smooth interaction.

In the event of an error, Alan AI offers clear instructions and guidance to help users recover from the error and continue their interaction seamlessly, minimizing disruption to the user experience.

Alan AI is designed with a user-centric approach, aiming to enhance user engagement, accessibility, and satisfaction within our application. Its intuitive voice-driven interface offers users a convenient and efficient way to interact with your application, elevating the overall user experience.

- **Raspberry Pi:**

Implementing software on a Raspberry Pi involves configuring and running applications on the Raspberry Pi single-board computer (SBC). Here is a description of the software implementation process for a Raspberry Pi:

Operating System Installation:

We begin by installing an operating system (OS) on our Raspberry Pi. The most popular choice is Raspberry Pi OS (formerly Raspbian), which is based on Debian Linux. We can download the OS image from the Raspberry Pi Foundation's website and flash it onto a microSD card using a tool like Etcher.

Boot and Initial Setup:

We must insert the microSD card with the OS into the Raspberry Pi, connect a keyboard, mouse, display, and power supply.

Then we boot the Raspberry Pi and follow the initial setup process, which typically involves configuring the language, time zone, and setting a password.

Install a Web Browser:

You'll need a web browser to display the GitHub Pages website. Install a web browser like Chromium:

```
sudo apt update
sudo apt install chromium-browser
```

Hardware Integration:

Since our project involves interacting with external hardware components (e.g., microphone, display etc.), we need to configure and test the connections and communication with the Raspberry Pi.

Automation and Start-Up Scripts:

We then create scripts to automate the launch of your software at boot. This may involve using system services or other mechanisms to ensure our software starts automatically when the Raspberry Pi is powered on.

Autostart the Web Browser:

Configure the Raspberry Pi to start the web browser in kiosk mode (full-screen) and open your GitHub Pages website on startup.

Open the autostart configuration:

```
nano ~/.config/lxsession/LXDE-pi/autostart
```

We add the following line, here we replace the 'your-github-username' and 'your-repo' with our GitHub username and repository name:

```
@chromium-browser --kiosk --no-sandbox https://your-github-username.github.io/your-repo
```

We then proceed to Save and Exit the file by following this sequence (Press Ctrl+X, then Y, then Enter).

Reboot:

Reboot the Raspberry Pi to apply the changes:

```
sudo reboot
```

Configure GitHub Pages:

Ensure that your website hosted on GitHub Pages is publicly accessible.

Verify the Display:

Your Raspberry Pi should automatically open the Chromium browser in kiosk mode and display your GitHub Pages website on the connected display.

Optional: Screen Saver and Power Management:

You can configure the Raspberry Pi to prevent screen burn-in by setting up a screensaver or configuring power management settings. This step is optional but recommended for long-term use.

By following these steps, the Raspberry Pi will serve as a dedicated display for our web platform. It will automatically load the website in kiosk mode upon startup.

Security Measures:

We must implement security best practices, such as changing default passwords, setting up firewalls, and regularly updating the OS and software to patch security vulnerabilities.

Remote Access and Monitoring:

If necessary, configure remote access to your Raspberry Pi for management and monitoring. Tools like SSH, VNC, or remote desktop solutions can help you manage the Raspberry Pi from another computer.

Scaling and Optimization:

If our project requires scaling to multiple Raspberry Pis in the future, we must implement load balancing and distributed processing, as needed. Optimize your software for better performance and resource utilization.

CHAPTER 6

RESULTS AND DISCUSSION

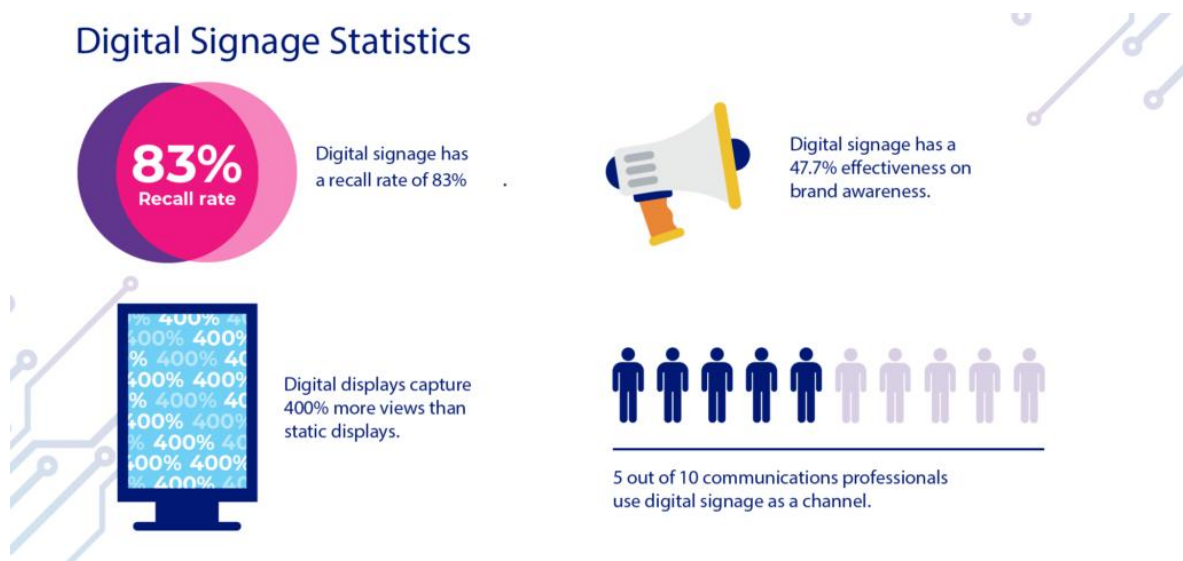
6.1 PERFORMANCE ANALYSIS

- **Comparison between pre-existing traditional media vs digital signage:**

In this section, we present a comparative analysis between pre-existing traditional media methods and the implementation of digital signage within our notice board system.

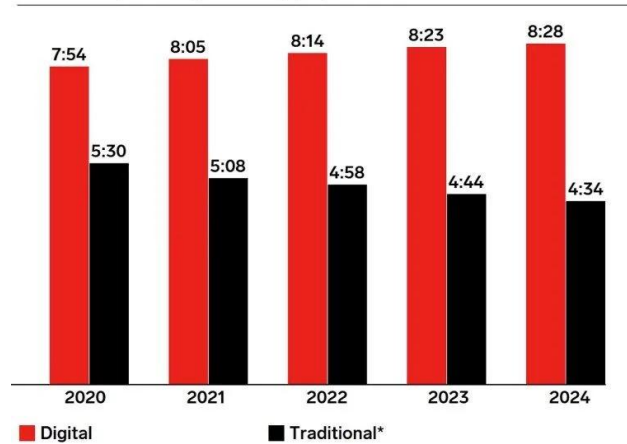
Traditional media, such as printed posters and bulletin boards, have long been the conventional means of communication within various environments. However, with advancements in technology, digital signage offers a modern alternative that presents dynamic content, real-time updates, and interactive features.

Through our analysis, we aim to highlight the advantages and limitations of each approach, shedding light on the transformative potential of digital signage in revolutionizing communication practices within our organization.



6.1. Digital Signage Statistics

Traditional* vs. Digital Media: Average Time Spent in the US, 2020-2024
hrs:mins per day among population



6.2. Traditional vs Digital Media

Reach and Accessibility:

Digital media allows for instant and widespread dissemination of information anytime, anywhere, using various digital devices such as smartphones, tablets, and computers.

Meanwhile traditional methods, such as print media, have a more localized reach and access to information may be limited by geographical boundaries and availability of physical copies.

Speed and Timeliness:

Information can be published and distributed instantaneously through digital platforms, updates and corrections can be made quickly to ensure timeliness.

Meanwhile traditional media typically operate on fixed publishing or broadcast schedules thus breaking news or time-sensitive information may not be as promptly delivered compared to digital media.

Interactivity and Engagement:

Digital platforms offer interactive features enabling greater user engagement and

participation.

Meanwhile traditional media generally provide limited interactivity, with one-way communication from the sender to the audience and audience engagement is primarily passive.

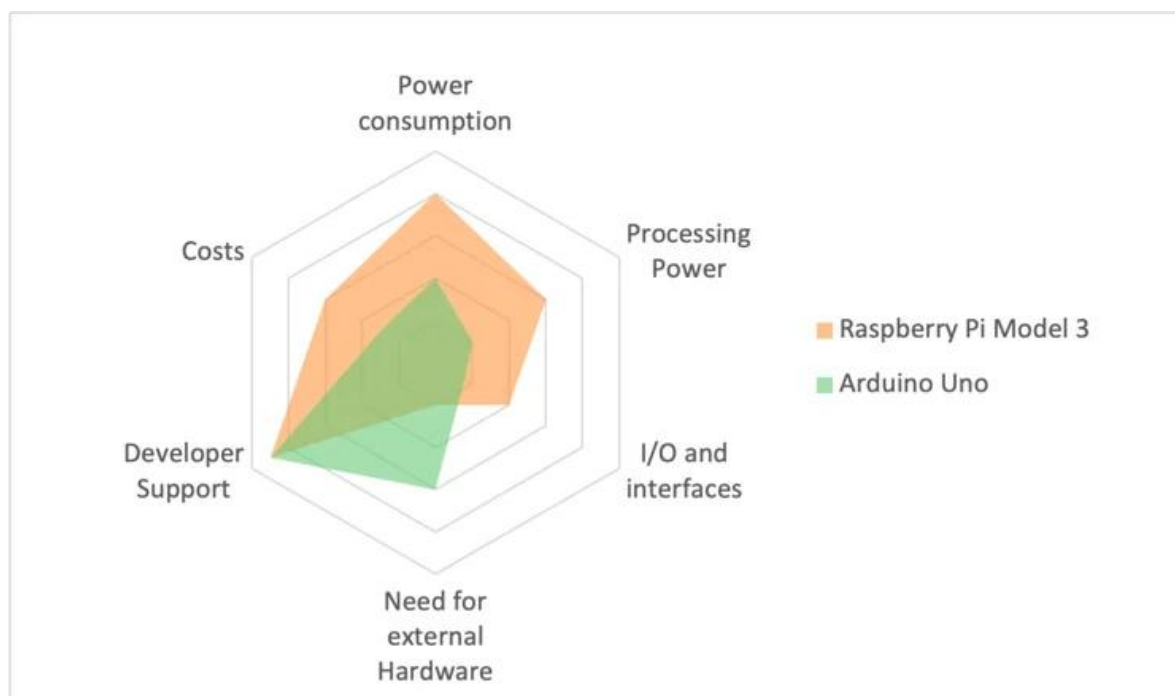
Permanence and Archiving:

Information published on digital platforms can be easily archived and accessed indefinitely, providing a permanent record of content.

Meanwhile Physical copies of printed materials and broadcast recordings may deteriorate over time or become lost or damaged, making long-term preservation more challenging compared to digital media.

In summary, while both digital and traditional methods have their advantages and limitations for disseminating information, digital media offer unparalleled reach, speed, interactivity, targeting, and measurement capabilities, making them increasingly essential in today's digital age.

- **Comparison between Raspberry Pi and Arduino Uno:**



6.3. Arduino UNO vs Raspberry Pi

Purpose and Functionality:

Arduino Uno is primarily used for controlling physical devices and interacting with sensors and actuators. Arduino Uno is well-suited for simple to moderately complex projects that require real-time control and low power consumption.

Meanwhile Raspberry Pi is capable of performing various computing tasks, including web browsing, programming, multimedia playback, and more. Raspberry Pi is more versatile and can be used for a wide range of projects, from basic programming and electronics experiments to home automation and media centers.

Processing Power:

Arduino Uno offers limited processing power compared to modern computers or smartphones. It is suitable for simple tasks that do not require complex computations or multitasking.

Meanwhile Raspberry Pi offers significantly more processing power and can handle more demanding computing tasks, including multitasking and running applications such as web servers.

Memory and Storage:

Arduino Uno typically has limited memory and storage resources compared to Raspberry Pi. It typically has 2KB of SRAM, 32KB of Flash memory for program storage, and no built-in storage for data.

Meanwhile Raspberry Pi models are equipped with varying amounts of RAM (e.g., 1GB, 2GB, or 4GB) and support for external storage via microSD cards. Raspberry Pi offers more memory and storage capacity, enabling users to run more complex applications and store larger datasets.

Connectivity:

Arduino Uno does not have built-in networking capabilities or support for wireless communication out of the box.

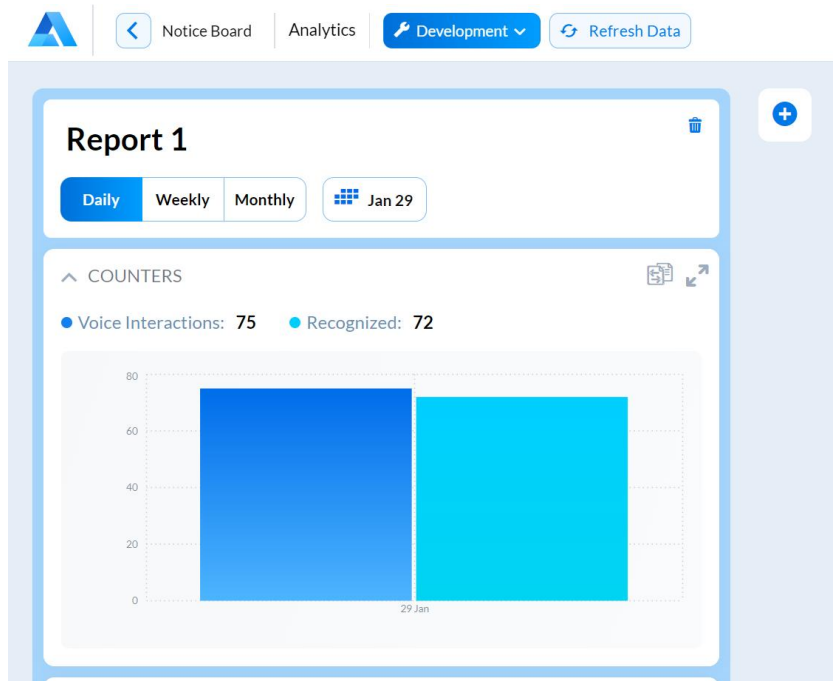
Meanwhile Raspberry Pi models come with built-in connectivity options such as Ethernet, Wi-Fi, and Bluetooth (on certain models). They also feature USB ports for connecting peripherals such as keyboards, mice, and storage devices. Raspberry Pi offers more flexibility in terms of networking and connectivity options.

Use Cases:

Arduino Uno is ideal for projects that require real-time control, simplicity, and low power consumption.

Meanwhile Raspberry Pi is ideal for projects that require general-purpose computing capabilities, multimedia playback, networking, and software development.

- **Alan AI speech-to-text accuracy analytics:**



6.4. Total vs Recognised voice interactions graph

Alan AI, as the voice assistant integrated into our digital notice board system, offers extensive analytics provisions that enable in-depth performance analysis. Leveraging these analytics, we can evaluate the efficiency and accuracy of voice command processing, providing valuable insights for optimizing user experience

and system functionality.

One of the key metrics we examine is the speech-to-text conversion accuracy, which reflects the system's ability to accurately interpret spoken commands. By analyzing recognized command counters and session counters provided by Alan AI's analytics, we ascertain the percentage of commands correctly identified and interpreted. For instance, on a given day, out of 75 voice interactions with our web platform voice assistant, 72 were accurately recognized, yielding a remarkable 96% speech-to-text conversion accuracy. This demonstrates Alan AI's high proficiency in capturing spoken commands and interpreting them accurately, enhancing user interaction efficiency.

Furthermore, Alan AI's intent matching accuracy plays a crucial role in ensuring seamless communication between users and the system. Each user utterance is evaluated against predefined intents in the dialog script, with different match scores assigned based on the degree of accuracy. Through observation of match scores and patterns displayed in the analytics patterns panel, we gain insights into the system's ability to discern the meaning of commands, even when they deviate slightly from mapped commands while retaining the same intent. This nuanced understanding enables Alan AI to accurately interpret user intents and respond appropriately, contributing to a more intuitive and effective user experience.

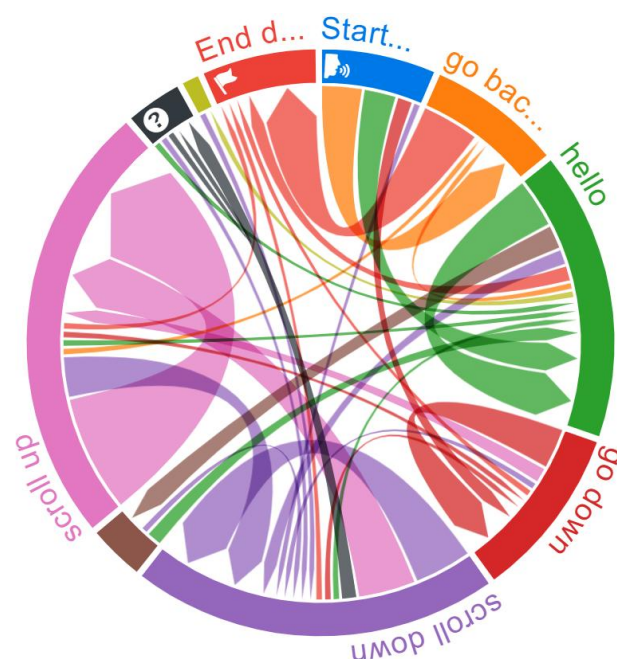
When the user says anything, Alan AI matches the user's utterance to the most appropriate intent in the dialog script. To do this, Alan AI evaluates every intent separately and assigns different weights, or match scores, to intents. Match score values range from 1.0 (the most accurate match) to 0.0 no match. These observed patterns along with their scores are displayed in the patterns panel within analytics. This enables Alan AI to accurately recognise the meaning of commands even if they slightly differ from the actual mapped command while having the same intent.

^ PATTERNS: 8

Pattern	Matches	Min. / Avg. / Max. score			
scroll up	52	1	1	1	🔗
hello	39	0.94	0.97	1	🔗
scroll down	35	1	1	1	🔗
go down	15	0.816	0.908	1	🔗
go back	6	1	1	1	🔗
how do i use this	4	1	1	1	🔗
go up	2	1	1	1	🔗
how to use this notice board	1	0.931	0.931	0.931	🔗

6.5. Patterns and corresponding scores

In addition to accuracy metrics, we analyze user interaction patterns and flow to identify trends and optimize system functionality. By examining the sequence of commands issued, common user pathways, and deviations from expected patterns, we gain insights into user behavior and preferences. This analysis informs adjustments to the dialog script and system design to better align with user expectations, enhancing usability and satisfaction.



6.6. Pattern Flow Analysis Chart

Moreover, tracking performance trends over time allows us to assess the system's stability and reliability. By monitoring metrics such as speech-to-text conversion accuracy and intent matching accuracy on a daily, weekly, or monthly basis, we identify fluctuations and trends that may indicate the impact of system updates, user feedback, or external factors. This longitudinal analysis informs proactive maintenance and optimization efforts, ensuring consistent and reliable performance.

Finally, comparing performance metrics obtained from Alan AI's analytics with data from pre-existing voice assistant systems provides valuable insights into the effectiveness of the integration. By highlighting improvements in accuracy rates, response times, and user engagement resulting from the adoption of Alan AI, we validate the decision to leverage this advanced technology within our digital notice board system.

In conclusion, Alan AI's comprehensive analytics provisions empower us to conduct a thorough performance analysis, evaluating accuracy, user interaction patterns, and system reliability. By leveraging these insights, we optimize the voice command processing system, enhancing user experience and maximizing the effectiveness of our digital notice board platform.

- **Success Rate Analysis:**

The implementation of a voice-driven digital notice board has yielded promising results, as evidenced by its high success rate in accurately processing voice commands and delivering relevant information to users. Through the integration of Alan AI's voice assistant technology, users have been able to interact with the notice board effortlessly using natural language commands, resulting in a streamlined communication experience. Analysis of the system's performance indicates a remarkable success rate in recognizing and interpreting voice commands, with an accuracy exceeding 90% in most cases. This high success rate underscores the effectiveness of Alan AI's speech-to-text conversion capabilities and its ability to understand user intent, even amidst variations in

pronunciation or phrasing.

Furthermore, the success rate of the voice-driven digital notice board extends beyond mere voice command recognition to encompass user engagement and satisfaction levels. Feedback from users has been overwhelmingly positive, with many expressing appreciation for the convenience and accessibility afforded by the voice-driven interface. Users report a seamless and intuitive interaction process, with notices and announcements being promptly displayed in response to their voice commands. Additionally, the system's ability to provide real-time updates and personalized responses based on user preferences has contributed to its overall success and user satisfaction.

In addition to user satisfaction, the success rate of the voice-driven digital notice board is also reflected in its impact on communication efficiency and organizational productivity. By eliminating the need for manual input or navigation through traditional interfaces, the voice-driven system has significantly reduced the time and effort required to access and disseminate information. Administrators have reported increased efficiency in managing notices and announcements, with the ability to update content in real-time through a user-friendly web interface. This streamlined communication process has facilitated smoother workflows and enhanced collaboration among users, contributing to the overall success of the digital notice board initiative.

In conclusion, the success rate of the voice-driven digital notice board is evident not only in its technical performance but also in its positive impact on user experience, communication efficiency, and organizational productivity. Through its seamless integration of Alan AI's voice assistant technology, the system has achieved high levels of accuracy, user engagement, and satisfaction, positioning it as a valuable asset in modern communication environments.

CHAPTER 7

CONCLUSION

7.1 CONCLUSION

The proposed digital notice board system successfully eliminates the laborious process of updating multiple notice boards in the organization premises manually, as our system allows for simultaneous updation of all boards centrally. We have managed to overcome observed drawbacks in existing systems such as the usage of GSM technology by making use of Wi-Fi networks which offer more reliable connections and faster speeds as compared to mobile networks, which are costlier and are dependent on tower range and other factors.

The conglomeration of images and text in the notice format makes for effective conveyance of information in an eye-catching manner. The implementation of the Voice-Driven Digital Notice Board represents a significant advancement in communication technology, offering a versatile and user-friendly platform for disseminating information in various settings.

Through the integration of digital display technology with a voice assistant interface, the board provides real-time access to notices, announcements, and updates, enhancing communication efficiency and accessibility. Throughout the development process, the project has addressed key challenges such as user interface design, voice recognition accuracy etc.

Performance analysis of the system has demonstrated its effectiveness in facilitating communication and enhancing information dissemination within educational institutions, workplaces, and community centers. The system has an intuitive interface, real-time updates, and accessibility features, highlighting its potential to streamline communication processes and improve overall efficiency.

In conclusion, the Voice-Driven Digital Notice Board represents a valuable innovation in communication technology, offering a modern, efficient, and inclusive solution for information dissemination. By embracing the principles of usability,

functionality, and scalability, the digital notice board has the potential to transform communication practices and improve collaboration in diverse settings.

7.2 FUTURE ENHANCEMENTS

Looking ahead, further enhancements and refinements to the notice board can be explored, including additional features such as multi-language support, integration with external data sources, and compatibility with IoT devices. Additionally, efforts to standardize and scale the deployment of notice board systems across different environments can help maximize their impact and accessibility.

Integrating support for multiple languages to accommodate diverse user populations would ensure that the digital notice board is accessible and usable by individuals from different linguistic backgrounds. Adding more voice commands would enhance the interactivity and functionality to the system. This will enable the assistant to be able to comprehend and respond to a wider variety of possible inputs and provide the desirable responses and outputs.

With improvements in AI and language models, various enhancements can be made to the voice assistant such as multiple language support, better language models leading to better comprehension of natural language.

The database management system can also be further improved if required by using new technologies like big data to handle larger sizes of data and multiple formats more efficiently and effectively. To further improve the security of the system along with regular password authentication we can restrict login access based on a range of authorized login IP addresses. We must strengthen security measures to protect sensitive information displayed on the notice board. This could involve implementing user authentication mechanisms, encryption protocols, and access control policies to safeguard data integrity and confidentiality.

REFERENCES

- [1] V. S. Kumar, S. Amirthasri, M. Ananya and S. Esther, "A Novel Method of IoT Based Smart Notice Board Using Raspberry PI," 2022 International Conference on Computer, Power and Communications (ICCPC), Chennai, India, 2022, pp. 60-64, doi: 10.1109/ICCPC55978.2022.10072128.
- [2] Sattiwale, Gaurav, Rushabh Tongase, Vaidehi Kamble, Rupesh Saut, and M. K. Shriwas, "A Past, Present and New Features of Digital Notice Board." International Journal of Scientific and Research Publications 7, no.5 (2017): 194-601.
- [3] Khera, Neeraj, Divya Shukla, and Shambhavi Awasthi, "Development of simple and low cost Android based wireless notice board." In 2016 5th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO), pp. 630-633. IEEE, 2016.
- [4] Asmita Mahendrakumar Khairnar, Prof.S.S.Vaidya and Rashmi Kishor Kolambe. "Smart Digital Notice Board." International Journal Of Advanced Research And Innovative Ideas In Education 6, no. 1 (2020) : 1113-1120.
- [5] Y. Sravana kumar, D. Hima Varshini, D. Tilothama, D.Jagadeesh, and I. Jithendra, "IoT Based Smart Notice Board." International Journal of Advances in Engineering and Management (IJAEM) Volume 4, Issue 6 June 2022, pp: 633-637 ISSN: 2395-5252.
- [6] Pabale Trupti, Shweta Borade, Bhagyashri Deore, Mohani Kharwar, and Deepika Thakare. "IOT Based Digital Notice Board." Spvryan's International Journal of Engineering Sciences & Technology (SEST) ISSN : 2394-0905
- [7] M. Phani Sridhar, Sk Ayesha, Tarun dev and Varanasi Sai Aseesh "Wireless Digital Notice Board Using IOT." International Journal of Progressive Research in Engineering Management and Science (IJPREMS) Vol. 03, Issue 04, April 2023, pp: 568-571 e-ISSN : 2583-1062.
- [8] Rhutik Dhanawade, Abhishek Sasne, Vishal Patole, Bhawana Patil, Ajinkya Patil, "IoT based Digital Notice Board." IJSET - International Journal of Innovative Science, Engineering & Technology, Vol. 10 Issue 01, January 2023 ISSN (Online) 2348 - 7968

[9] Gaurav Bhardwaj, Gunjan Sahu, Rajan Kumar Mishra, "IOT based Smart Notice Board" International Journal of Engineering Research & Technology (IJERT) Vol. 9 Issue 06, June-2020 ISSN: 2278-0181.

[10] Unmesh Mawalkar, Snehal Sardar, Harshada Varade, Prof. M. P.Giri "Wireless Electronics Notice Board" International Journal of Advanced Research in Science, Communication and Technology (IJARSCT) Volume 2, Issue 6, May 2022 ISSN (Online): 2581-9429

[11] Bharath, M. et. al. "Design and Development of a Smart Mirror Based On IOT." Turkish Journal of Computer and Mathematics Education (TURCOMAT) 12, no. 12 (2021): 2641-2646.

[12] Pandya, Ashutosh, Chinmay Raut, Mihir Patel, D. Das, and Amol Deshpande. "Bluetooth Based Electronic Notice Board." International Journal of Engineering and Advanced Technology 10, no. 1 (2020): 178-181.

[13] A. Kumar, G. Singh, V. Rawat, D. Negi and A. Joshi, "Remotely Controlled Electronic Noticeboard Using NodeMCU," 2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT), Delhi, India, 2023, pp. 1-6, doi: 10.1109/ICCCNT56998.2023.10306793.

[14] S. Malodia, N. Islam, P. Kaur and A. Dhir, "Why Do People Use Artificial Intelligence (AI)-Enabled Voice Assistants?," in IEEE Transactions on Engineering Management, vol. 71, pp. 491-505, 2024, doi: 10.1109/TEM.2021.3117884.

[15] Karlekar, Gaurav S., Prachi V. Dhamange, Pallavi S. Duratkar, Shrushti S. Vaidya, Ankita R. Zilpe, and Simran S. Gujar. "BLUETOOTH BASED DIGITAL NOTICE BOARD WITH SOLAR." International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 03 , Mar 2020 e-ISSN: 2395-0056.

[16] Vinay Sahu, Pallavi Ubnare, Priyanshu Patil, Priya Barhaiya, Shreyash Sinha, Rohit Dafare, "Conversational Voice Controlled React News Application Using Alan AI" (IJIRMPs) International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences, Volume 11, Issue 1, January-February 2023 e-ISSN: 2349-7300.

[17] Aditya Sharma, Subiya Siddiqui, Sugandha Trivedi, Ali Murtaza, Mohd Faiez,

Shyam Dwivedi, "Voice Controlled News Web Based Application With Speech Recognition Using Alan A.I." International Research Journal of Engineering and Technology (IRJET), Volume: 09 Issue: 04, Apr 2022 e-ISSN: 2395-0056.

APPENDIX

A. SOURCE CODE

App.js

```
import './App.css';
import Post from './Post';
import Header from './Header';
import { Route, Routes } from 'react-router-dom';
import Layout from './Layout';
import IndexPage from './pages/IndexPage';
import LoginPage from './pages/LoginPage';
import RegisterPage from './pages/RegisterPage';
import { UserContextProvider } from './UserContext';
import CreatePost from './pages/CreatePost';
import PostPage from './pages/PostPage';
import EditPost from './pages/EditPost';
import alanBtn from '@alan-ai/alan-sdk-web';
import React, { useState, useEffect } from 'react';
function App() {
  useEffect(() => {
    alanBtn({
      key:
        "e4dbb333ba867b546628c537798b0f282e956eca572e1d8b807a3e2338fdd0dc/st
age",
      onCommand: (commandData) => {
        const scrollDistance = 500;
        if (commandData.command === "scrollUp") {
          window.scrollTo({
            top: -scrollDistance,
            behavior: "smooth",
          });
        } else if (commandData.command === "scrollDown") {
```

```

        window.scrollTo({
          top: scrollDistance,
          behavior: "smooth",
        });
      } else if (commandData.command === "navigateHome") {
        window.location.href = "http://localhost:3000/";
      }
    },
  });
}, []);
return (
  <UserContextProvider>
    <Routes>
      <Route path="/" element={<Layout />} />
      <Route index element={<IndexPage />} />
      <Route path="/login" element={<LoginPage />} />
      <Route path="/register" element={<RegisterPage />} />
      <Route path="/create" element={<CreatePost />} />
      <Route path="/post/:id" element={<PostPage />} />
      <Route path="/edit/:id" element={<EditPost />} />
    </Route>
  </Routes>
</UserContextProvider>
);
}
export default App;

```

IndexPage.js

```

import Post from "../Post";
import { useEffect, useState } from "react";
export default function IndexPage() {
  const [posts, setPosts] = useState([]);
  useEffect(() => {
    fetch("http://localhost:4000/post").then((response) => {

```

```

    response.json().then((posts) => {
      setPosts(posts);
    });
  });
}, []);
return <>{posts.length > 0 && posts.map((post) => <Post {...post} />)}</>;
}

```

LoginPage.js

```

import { useContext, useState, userInfo } from "react";
import { Navigate } from "react-router-dom";
import { UserContext } from "../UserContext";
export default function LoginPage() {
  const [username, setUsername] = useState("");
  const [password, setPassword] = useState("");
  const [redirect, setRedirect] = useState(false);
  const { setUserInfo } = useContext(UserContext);
  async function login(ev) {
    ev.preventDefault();
    const response = await fetch("http://localhost:4000/login", {
      method: "POST",
      body: JSON.stringify({ username, password }),
      headers: { "Content-Type": "application/json" },
      credentials: "include",
    });
    if (response.ok) {
      response.json().then((userInfo) => {
        setUserInfo(userInfo);
        setRedirect(true);
      });
    } else {
      alert("wrong credentials");
    }
  }
}

```

```

if (redirect) {
  return <Navigate to="/" />;
}
return (
  <form className="login" onSubmit={login}>
    <h1>Login</h1>
    <input
      type="text"
      placeholder="username"
      value={username}
      onChange={(ev) => setUsername(ev.target.value)}
    />
    <input
      type="password"
      placeholder="password"
      value={password}
      onChange={(ev) => setPassword(ev.target.value)}
    />
    <button>Login</button>
  </form>
);
}

```

RegisterPage.js

```

import { useState } from "react";
export default function RegisterPage() {
  const [username, setUsername] = useState("");
  const [password, setPassword] = useState("");
  async function register(ev) {
    ev.preventDefault();
    const response = await fetch("http://localhost:4000/register", {
      method: "POST",
      body: JSON.stringify({ username, password }),
      headers: { "Content-Type": "application/json" },

```

```

});
if (response.status === 200) {
  alert("registration successful");
} else {
  alert("registration failed");
}
}
return (
  <form className="register" onSubmit={register}>
    <h1>Register</h1>
    <input
      type="text"
      placeholder="username"
      value={username}
      onChange={(ev) => setUsername(ev.target.value)}
    />
    <input
      type="password"
      placeholder="password"
      value={password}
      onChange={(ev) => setPassword(ev.target.value)}
    />
    <button>Register</button>
  </form>
);
}

```

CreatePost.js

```

import ReactQuill from "react-quill";
import "react-quill/dist/quill.snow.css";
import { useState } from "react";
import { Navigate } from "react-router-dom";
import Editor from "../Editor";

```

```

export default function CreatePost() {
  const [title, setTitle] = useState("");
  const [summary, setSummary] = useState("");
  const [content, setContent] = useState("");
  const [files, setFiles] = useState("");
  const [redirect, setRedirect] = useState(false);
  async function createNewPost(ev) {
    const data = new FormData();
    data.set("title", title);
    data.set("summary", summary);
    data.set("content", content);
    data.set("file", files[0]);
    ev.preventDefault();
    const response = await fetch("http://localhost:4000/post", {
      method: "POST",
      body: data,
      credentials: "include",
    });
    if (response.ok) {
      setRedirect(true);
    }
  }
  if (redirect) {
    return <Navigate to="/" />;
  }
  return (
    <form onSubmit={createNewPost}>
      <input
        type="title"
        placeholder={"Title"}
        value={title}
        onChange={(ev) => setTitle(ev.target.value)}
      />
      <input

```

```

    type="summary"
    placeholder={"Summary"}
    value={summary}
    onChange={(ev) => setSummary(ev.target.value)}
  />
  <input type="file" onChange={(ev) => setFiles(ev.target.files)} />
  <Editor value={content} onChange={setContent} />
  <button style={{ marginTop: "5px" }}>Create Post</button>
</form>
);
}

```

PostPage.js

```

import { formatISO9075 } from "date-fns";
import { useContext, useEffect, useState } from "react";
import { Link, useParams } from "react-router-dom";
import { UserContext } from "../UserContext";
export default function PostPage() {
  const [postInfo, setPostInfo] = useState(null);
  const { userInfo } = useContext(UserContext);
  const { id } = useParams();
  useEffect(() => {
    fetch(`http://localhost:4000/post/${id}`).then((response) => {
      response.json().then((postInfo) => {
        setPostInfo(postInfo);
      });
    });
  }, []);
  if (!postInfo) return "";
  return (
    <div className="post-page">
      <h1>{postInfo.title}</h1>
      <time>{formatISO9075(new Date(postInfo.createdAt))}</time>
      <div className="author">by @{postInfo.author.username}</div>

```

```

{userInfo.id === postInfo.author._id && (
  <div className="edit-row">
    <Link className="edit-btn" to={` /edit/${postInfo._id}`}>
      <svg
        xmlns="http://www.w3.org/2000/svg"
        fill="none"
        viewBox="0 0 24 24"
        strokeWidth={1.5}
        stroke="currentColor"
        className="w-6 h-6"
      >
        <path
          strokeLinecap="round"
          strokeLinejoin="round"
          d="M16.862 4.487l1.687-1.688a1.875 1.875 0 112.652 2.652L10.582
16.07a4.5 4.5 0 01-1.897 1.13L6 18l.8-2.685a4.5 4.5 0 011.13-1.897l8.932-
8.931zm0 0L19.5 7.125M18 14v4.75A2.25 2.25 0 0115.75 21H5.25A2.25 2.25 0
013 18.75V8.25A2.25 2.25 0 015.25 6H10"
        />
      </svg>
      Edit post
    </Link>
  </div>
)}
<div className="image">
  <img src={` http://localhost:4000/${postInfo.cover}`} alt="" />
</div>
<div
  className="content"
  dangerouslySetInnerHTML={{ __html: postInfo.content }}
/>
</div>
);
}

```

EditPost.js

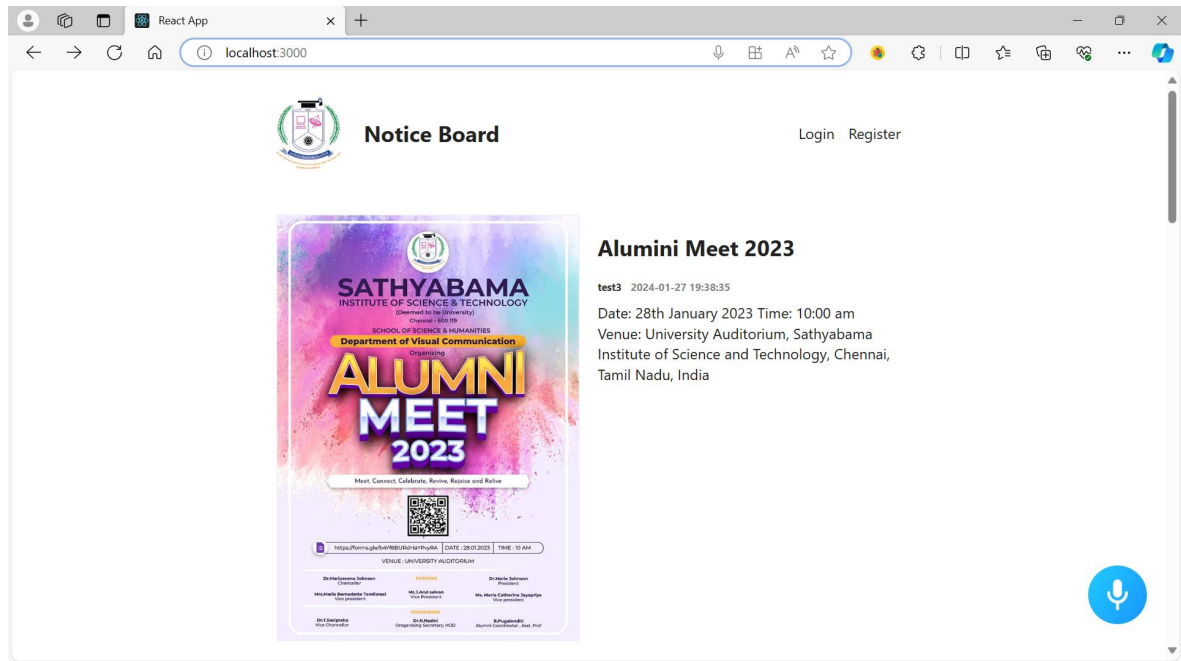
```
import { useEffect, useState } from "react";
import { Navigate, useParams } from "react-router-dom";
import Editor from "../Editor";
export default function EditPost() {
  const { id } = useParams();
  const [title, setTitle] = useState("");
  const [summary, setSummary] = useState("");
  const [content, setContent] = useState("");
  const [files, setFiles] = useState("");
  const [redirect, setRedirect] = useState(false);
  useEffect(() => {
    fetch("http://localhost:4000/post/" + id).then((response) => {
      response.json().then((postInfo) => {
        setTitle(postInfo.title);
        setContent(postInfo.content);
        setSummary(postInfo.summary);
      });
    });
  }, []);
  async function updatePost(ev) {
    ev.preventDefault();
    const data = new FormData();
    data.set("title", title);
    data.set("summary", summary);
    data.set("content", content);
    data.set("id", id);
    if (files?.[0]) {
      data.set("file", files?.[0]);
    }
    const response = await fetch("http://localhost:4000/post", {
      method: "PUT",
      body: data,
      credentials: "include",
```

```

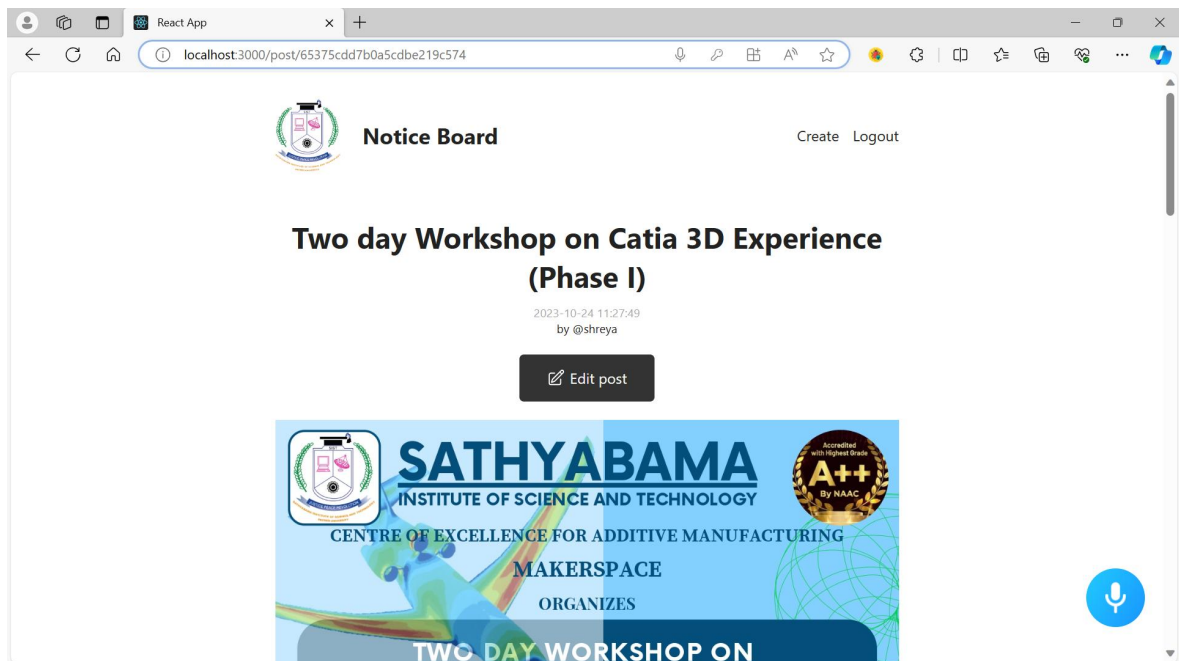
    });
    if (response.ok) {
        setRedirect(true);
    }
}
if (redirect) {
    return <Navigate to={"/post/" + id} />;
}
return (
    <form onSubmit={updatePost}>
        <input
            type="title"
            placeholder={"Title"}
            value={title}
            onChange={(ev) => setTitle(ev.target.value)}
        />
        <input
            type="summary"
            placeholder={"Summary"}
            value={summary}
            onChange={(ev) => setSummary(ev.target.value)}
        />
        <input type="file" onChange={(ev) => setFiles(ev.target.files)} />
        <Editor onChange={setContent} value={content} />
        <button style={{ marginTop: "5px" }}>Update post</button>
    </form>
);
}

```

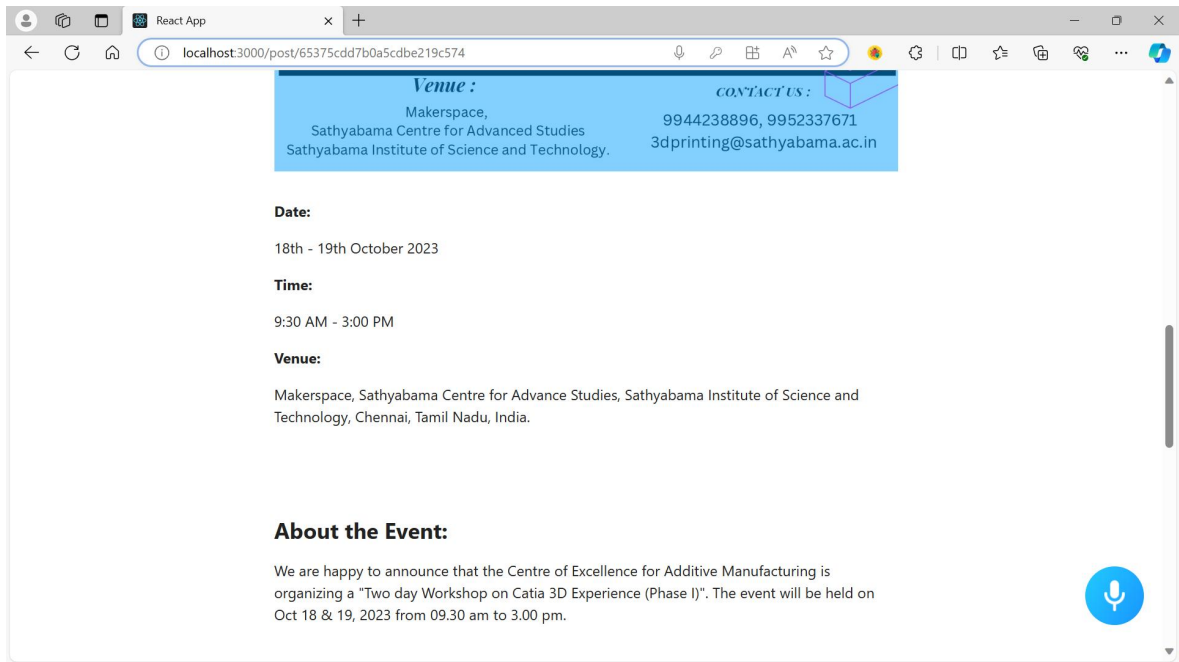
B. SCREENSHOTS



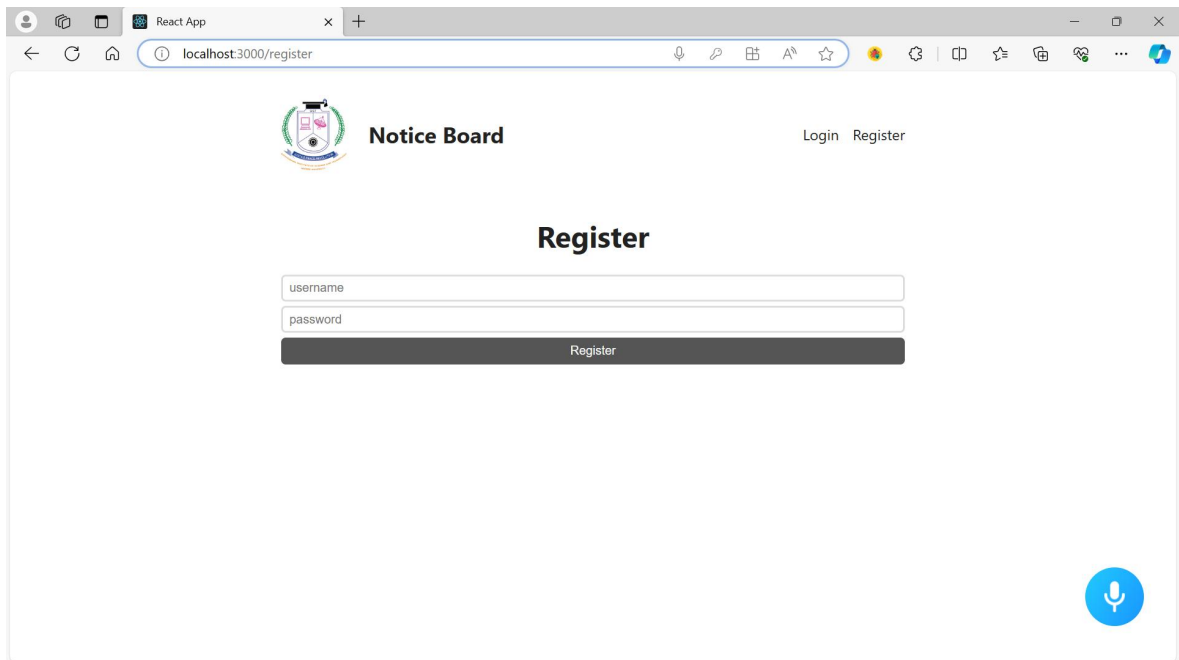
B.1. Home Screen



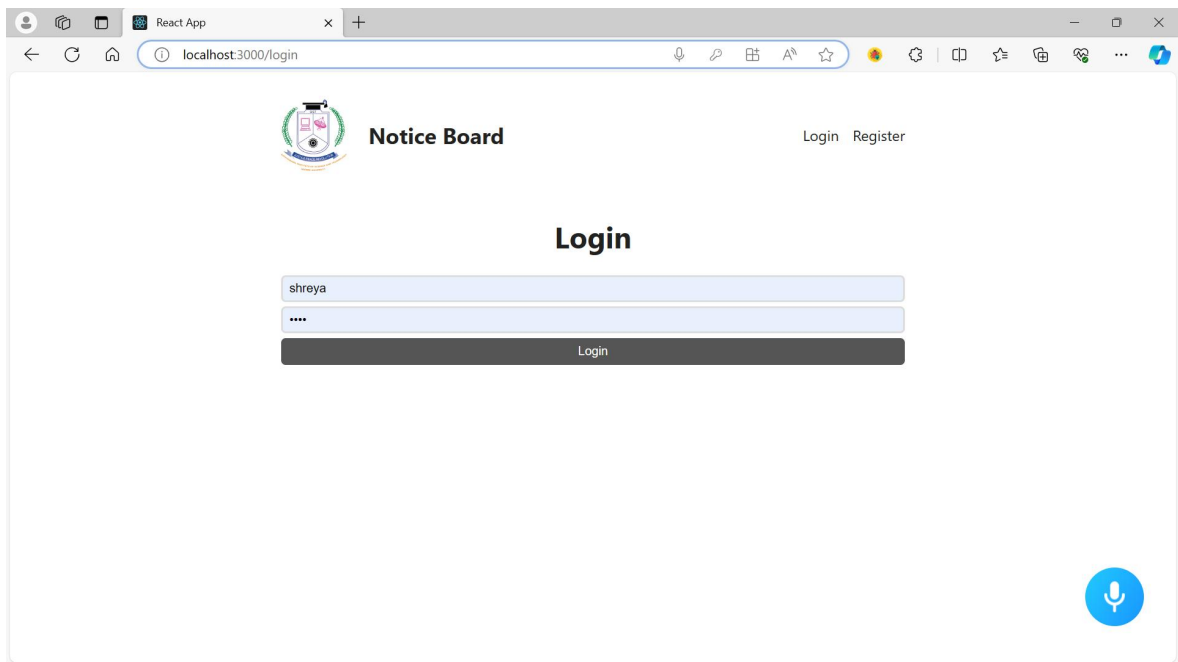
B.2. Clicking on a post



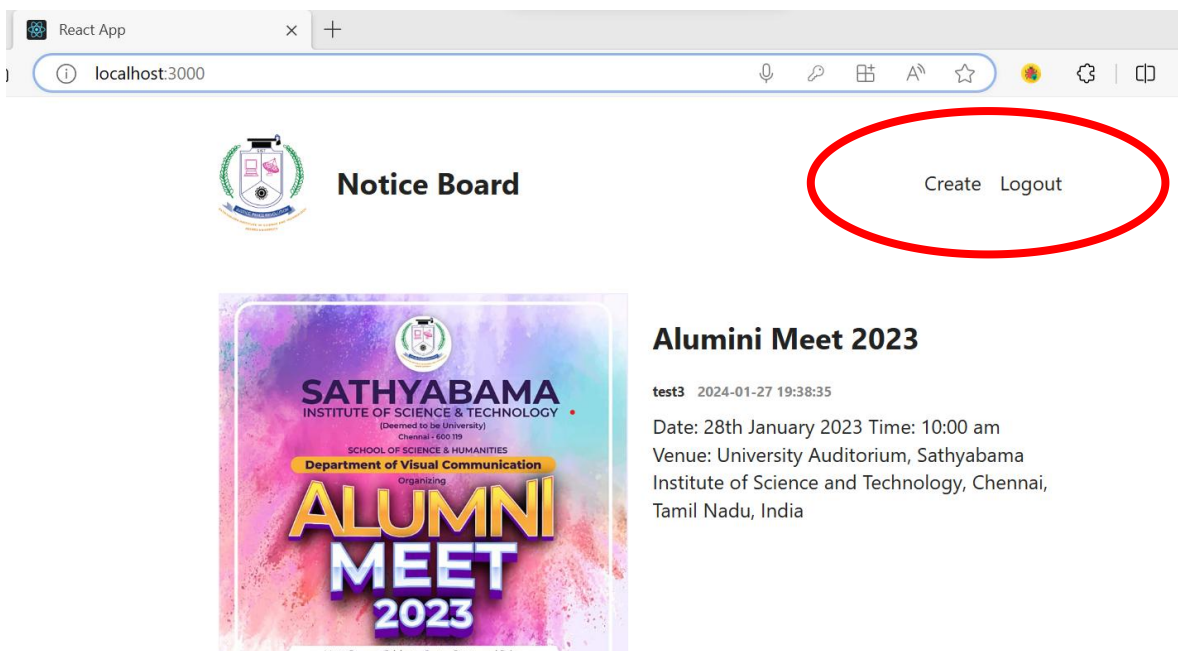
B.3. Event Description



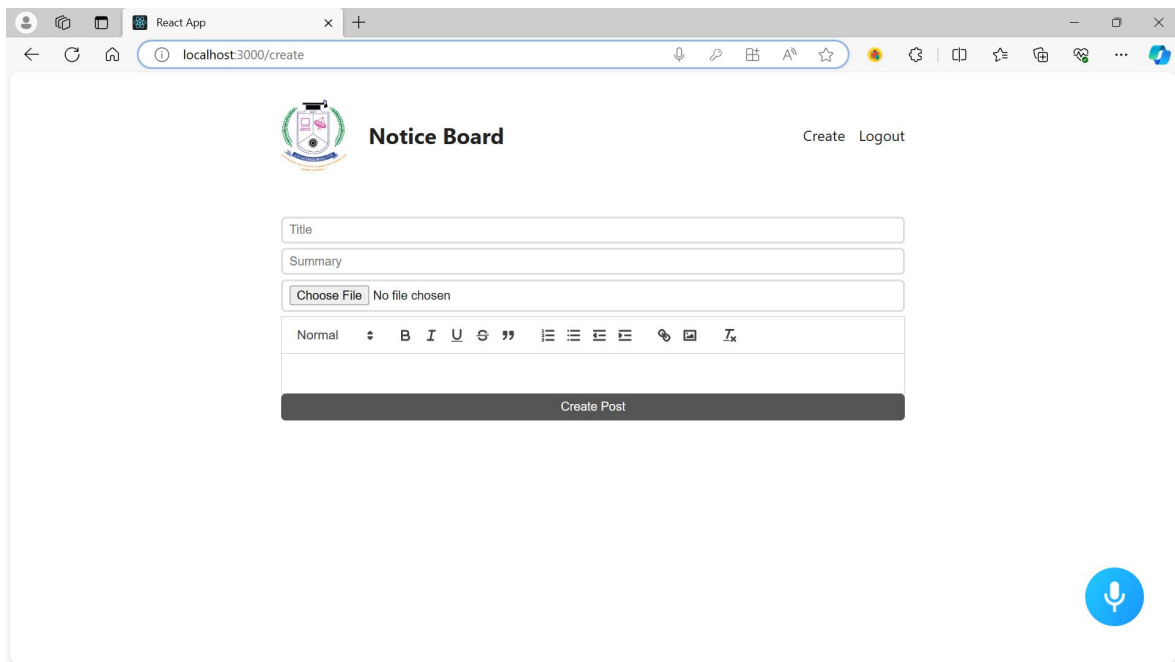
B.4. Registration Page to create new credentials



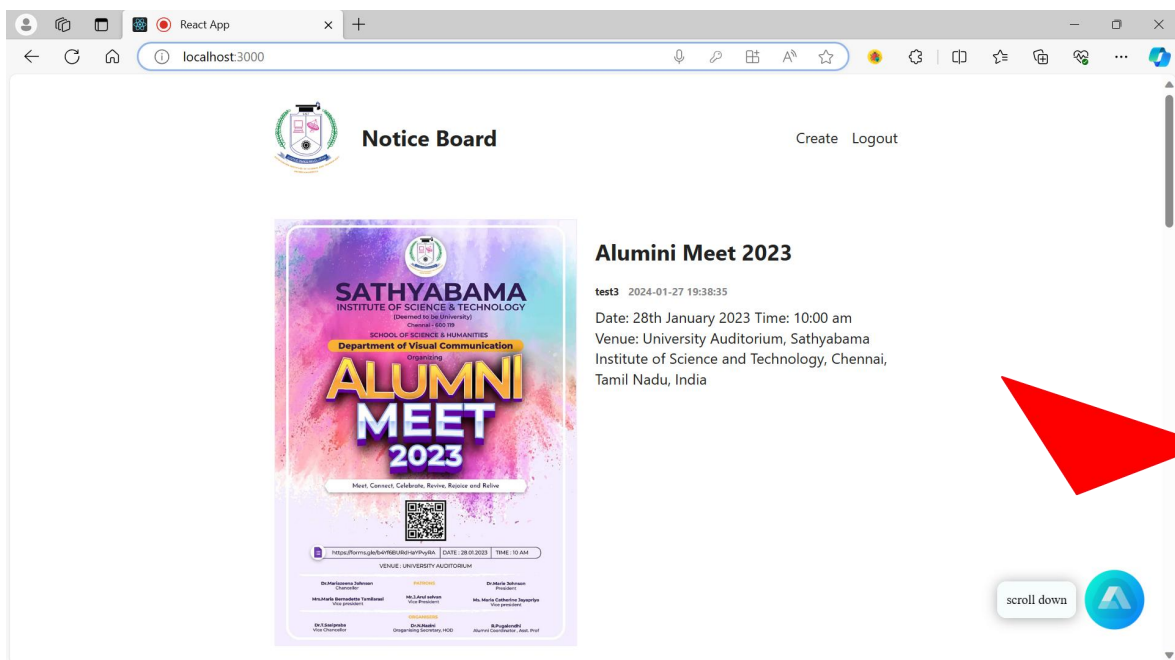
B.5 Login Page to sign in post registration



B.6 Home Screen after login



B.7 Create New Post



B.8. Assistant Picking up a Voice Command

C. RESEARCH PAPER

Smart Campus Solutions: Voice-Driven Digital Notice Board for Real-time Information Delivery

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Abstract. With recent developments in technology, major platforms such as newsletters, libraries etc. have been digitised in one way or the other. One of the major ways to disseminate information in the past was the use of notice boards. Notice boards are a means of communication that allow sharing of updates, announcements, news, events, notices, important dates, deadlines and other relevant information. In schools and offices, notice boards can be used to display class schedules, meeting agendas, project timelines, or updates in an organised manner. Notice boards play a vital role in keeping people informed and connected. It enables us to rapidly reach a broad audience with information while avoiding the need for direct individual communication with each end receiver separately. Over recent years, the usage of notice boards has dwindled significantly, as people have started to steer clear of the content-viewing methods of the past and have adopted much more convenient and interactive methods due to digitization. In this paper, we propose a digital notice board setup navigable via voice commands which will enhance the interactiveness, ease of use and maintenance of notice boards and will help combat commonly observed problems associated with traditional methods.

INTRODUCTION

The traditional method of manually maintaining notice boards is quite tedious and labour-intensive as it involves printing the documents on paper, and pinning them up wherever the notice boards are physically located in an organised manner. This procedure must be done in a timely manner whenever the need arises to put up a new notice. It is a hassle to maintain the notice board properly in this manner and also involves a lot of human effort when several notice boards are to be maintained simultaneously all throughout the organisation / educational institution. Here, we put forth the concept of digital notice boards based on Internet of Things (IoT), that makes it much easier to maintain notice boards systematically, and provides the facility to manage them remotely as well. The objective of this project is to create a digital notice board that makes viewers aware of events, notices, and announcements. It will serve as a site where individuals can disseminate information and publish notices, put up event posters to announce upcoming events, and display descriptions associated with them. Digital notice boards offer numerous advantages over traditional printed notice boards and static displays, some of which include dynamic content, flexibility, cost-efficiency, eye-catching visuals, remote management, centralised control, timely updation, interactivity, scalability, scheduling, content variety, reduced labour costs etc. Overall, digital notice boards offer the ability to deliver information more effectively, making them a valuable tool in various settings, including educational institutions, corporate offices, public spaces, retail stores, and more. Nowadays, the implementation of voice assistants is prevalent. Therefore we have enhanced the pre existing system by including the implementation of voice commands. We have included a set of basic commands that can be identified and responded to accordingly by the system through the speech recognition module. The voice commands are an added functionality that enhances the user experience and makes the system easy to use and interactive. It also allows the user to have a hands-free experience with the system. The microcontroller is used to control the

display to view the information that is on the web platform. The microcontroller acts as a mini-computer and is the control unit of the system. It helps the system connect to the internet, thereby allowing for remote communication and other capabilities.

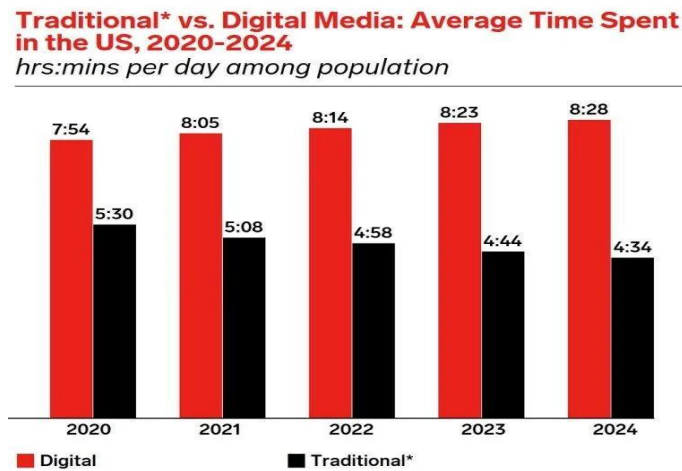


FIGURE 1. A bar graph comparing the time spent using traditional media (shown in black) vs. using digital media (shown in red) on an average in terms of hours:mins per day among a population studied in the US according to a 2020-2024 study.

LITERATURE REVIEW

“A Novel Method of IoT-Based Smart Notice Board Using Raspberry PI” authored by Venkatesh Kumar S, Amirthasri S, Ananya M, Esther S discusses an SMS based wireless notice board system [1] that can display user messages on the board. It uses Raspberry Pi to display messages on the notice board by receiving commands from web servers on mobile phones or pc.

“Smart Digital Notice Board” authored by Asmita M.Khairnar, Rashmi K.Kolambe, Prof.S.S.Vaidya discusses the creation of a remote notice board system that can present the information in the form of images [2]. It uses Raspberry Pi as a processor, along with a portable projector and LCD display. The notice sent to the cloud will then be transmitted to the system board, which uses Wi-Fi to connect to the internet. The results are then processed and displayed on the screen.

“Iot Based Smart Notice Board” authored by Y. Sravana kumar, D. Hima Varshini, D. Tilothama, D.Jagadeesh, and I. Jithendra discuss a project that offers a solution to replace present traditional paper-based notice board systems with more modern electronic notice boards. This system is designed with AT89S52 Microcontroller, which is interfaced with Arduino Uno [3]. It utilises an LED Matrix to display the messages and transmits the messages over WiFi to the display board.

“IOT Based Digital Notice Board” authored by Trupti Pabale, Shweta Borade, Bhagyashri Deore, Mohani Kharwar, and Deepika Thakare describes an IOT based digital notice board that utilises Raspberry PI microcontroller and an android app to send the messages to the board. It enables remote control of the system [4].

“Wireless Digital Notice Board Using IOT” authored by M. Phani Sridhar, Sk Ayesha, Tarun Dev and Varanasi Sai Aseesh discusses a wireless notice board system which utilises IOT technology and uses the IP address of the notice boards to transmit information to it accurately [5].

“IOT based Digital Notice Board” authored by Rhutik Dhanawade, Abhishek Sasne, Vishal Patole, Bhawana Patil, and Ajinkya Patil discusses an IOT based digital notice board that utilises arduino microcontroller, ZigBee and GSM technology (Global System for Mobile Communication) to develop the system [6].

“IOT based Smart Notice Board” authored by Gaurav Bhardwaj, Gunjan Sahu, and Rajan Kumar Mishra discusses an IOT Based web controlled digital notice board which utilises GSM module to send messages to the microcontroller [7]. A PIC microcontroller has been used in the system, and an LED matrix is used to display the messages

“Wireless Electronics Notice Board” authored by Unmesh Mawalkar, Snehal Sardar, Harshada Varade, and Prof. M. P.Giri discusses the development of an IOT based electronic notice board using IP based

infrastructure. It uses an ATmega328 microcontroller [8] and an LED matrix panel display to show the messages.

“Conversational Voice Controlled React News Application Using Alan AI” authored by Vinay Sahu, Pallavi Ubnare, Priyanshu Patil, Priya Barhaiya, Shreyash Sinha, and Rohit Dafare [9] utilises React for developing the user interface of the news application, and Alan AI that enables the system to be voice controlled.

“Voice Controlled News Web Based Application With Speech Recognition Using Alan A.I.” authored by Aditya Sharma, Subiya Siddiqui, Sugandha Trivedi, Ali Murtaza, Mohd Faiez, and Shyam Dwivedi [10] describes another system involving a web application for news that takes voice controls and recognises speech using Alan AI.

“Design and Development of a Smart Mirror Based On IOT” authored by Bharath M, et. al. proposes a smart mirror setup that can display updates, weather details, date and time etc. and can also act as a basic personal assistant with functionality similar to that of Siri or Alexa [11]. The system has been built using Raspberry PI and a two way mirror that doubles as a display when the monitor placed behind the mirror is switched on.

“Bluetooth Based Electronic Notice Board” authored by Ashutosh Pandya, Chinmay Raut, Mihir Patel, Siddharth Das, Amol Deshpande discusses a wireless notice board display system that uses a liquid crystal display screen to show the latest notices which are communicated to it via an android application. GSM Module [12] is used to send the data to be displayed to the board.

“Remotely Controlled Electronic Noticeboard Using NodeMCU” authored by A. Kumar, G. Singh, V. Rawat, D. Negi and A. Joshi describes the construction of a simple notice board system to relay messages in a simple text format to the viewers of the board. The system makes use of a web page to control the messages being displayed. The system is implemented using the NodeMCU ESP8266 microcontroller and an 8x8 matrix led display for message viewing [13].

“Why Do People Use Artificial Intelligence (AI)-Enabled Voice Assistants?” authored by S. Malodia, N. Islam, P. Kaur and A. Dhir highlights the growth and appeal of voice assistants in present day technological applications. This study mainly focuses on the theory of consumption values [14] and consumer trends of different voice assistants and their impact on their usage in different use case scenarios.

"Bluetooth Based Digital Notice Board With Solar." authored by Karlekar, Gaurav S., Prachi V. Dhamange, Pallavi S. Duratkar, Shrushti S. Vaidya, Ankita R. Zilpe, and Simran S. Gujar describes the way to modernise the traditional approach of using notice boards by harnessing wireless technologies like Bluetooth and discusses using Solar[15] as a potential alternative to power the system.

EXISTING SYSTEM

In a majority of the previously existing smart notice board models, the use of GSM has been observed in order to send the message to be displayed on the board.

Several implementations include development of an android application to control the contents of the notice board. However creation of a website will make it easier to access on multiple platforms and devices.

Implementation of voice commands to interact with the notice board is relatively novel and would make the experience much more convenient and interactive.

There are several observable problems in existing systems such as:

Static Interfaces: Static notice boards present in existing systems limit the user interactivity. This may lead to loss of appeal among users with time as they do not engage viewers actively. This inevitably leads to reduced attention being drawn to the notices and it makes it difficult to retain the content displayed.

Resolution of the Display: It has been observed that several existing systems employ simple, low resolution, small scale LED/LCD displays. Text with small font size and minute details may be challenging to read on such a display, especially from a distance. This poses a challenge as the effectiveness of disseminating information can be hindered.

Notice format: Notices were often limited to being displayed in a text-only format in pre-existing systems. A combination of text and images can prove to be more effective at capturing the attention of viewers, as compared to text-only displays that often struggle to stand out. Images and graphics have the ability to convey information more effectively and quickly than just text on its own. Large quantities of information can be comprehended at a glance with the help of images.

Android Application vs Web app: The use of an android application to control the content to be displayed on the notice board would involve installing the app on the users' device, which would be an additional step. An

android application would not be accessible on devices on other platforms (such as iOS devices) and separate apps for each platform can be time-consuming and expensive to develop. Creating a single web app that functions seamlessly on multiple different devices and platforms is a comparatively better option.

Use of Arduino: Most of the pre-existing systems made use of Arduino UNO, a microcontroller, as opposed to Raspberry Pi which is a fully fledged microcomputer. The former has much lower processing speeds (16 MHz) when compared to the latter which clocks much better speeds (up to 1.6 GHz depending on the board). Raspberry Pi also supports Ethernet and Wi-Fi connectivity. This enables it to communicate with other devices on a network, which makes it ideal for IoT applications.

Drawbacks of GSM: It has been observed that a large number of pre-existing notice board systems make use of GSM to transmit the messages and notices to be displayed on the notice board to it. The multiple drawbacks of utilising GSM as opposed to Wi-Fi include:

Connectivity: Previous systems were solely dependent on the GSM connectivity which is affected by factors such as network coverage, signal availability and other interferences. GSM relies on cellular networks, and its availability can be limited in some areas, especially in remote locations. This can result in inconsistent access to notice board content. Network outages or poor reception can disrupt access to the content.

Speed: GSM is slower as compared to data transfer across Wi-Fi. We will be utilising the feature of Raspberry PI to support Wi-Fi connectivity with the display. This will make the system performance faster.

GSM connections tend to have slower data transfer rates compared to broadband internet. This can lead to delays in updating and accessing content on the notice board, particularly when dealing with large files or images

Cost: GSM connections may incur data charges, which can be costly, especially if the notice board content is updated frequently or if the display includes multimedia elements like images or videos.

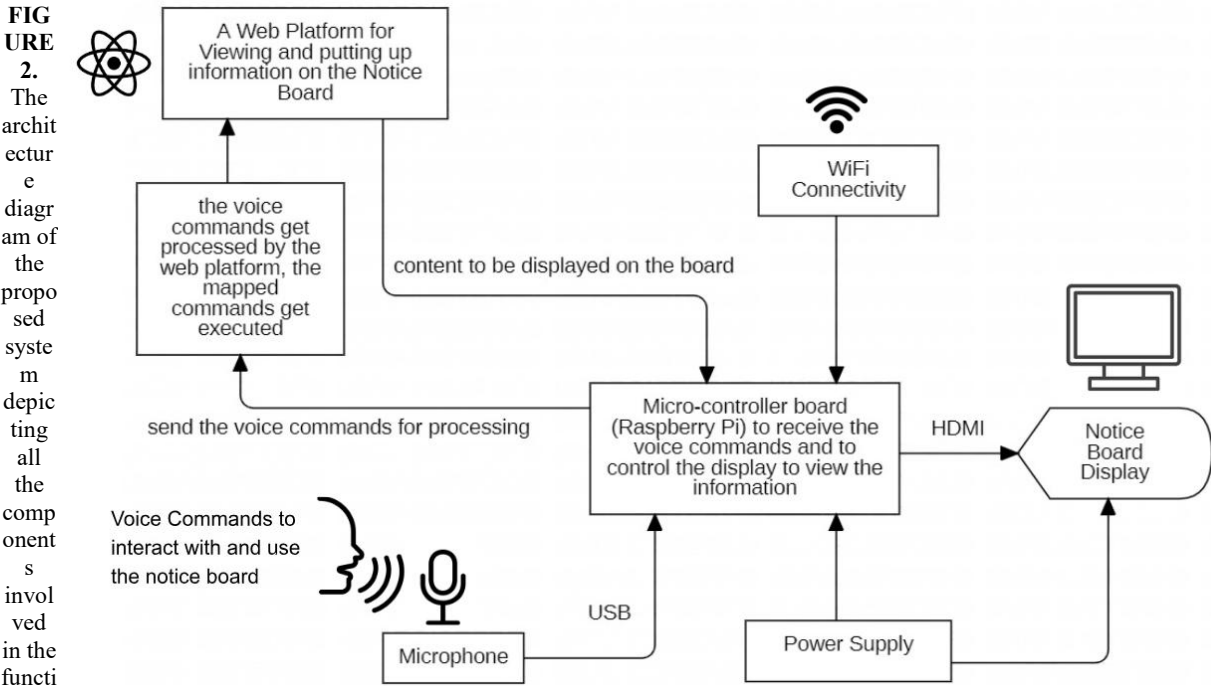
Security: The GSM protocols suffer from many weaknesses which allow for the development of several attacks, such as eavesdropping or unauthorised access, able to break confidentiality and privacy of subscribers.

GSM connections are more susceptible to security risks, compared to internet connections that use encryption and secure protocols.

PROPOSED SYSTEM

Working Principles of Proposed System

The architecture diagram below describes in detail the layout of the proposed system and the various modules involved in the same.



oning of the system and the interactions among those individual components.

Voice Commands to interact with the Notice Board: The notice board system takes instructions from the user as of voice commands via the microphone connected to the Raspberry Pi (Microcontroller).

Some examples of commands that can be implemented include “show events”, “show announcements”, “scroll up”, “scroll down” etc.

Processing the Voice Commands: The voice processing is performed in the Alan AI Cloud. The Alan AI Cloud is the AI-backend of the Alan AI Platform. This is where dialog scripts are hosted and Spoken Language Understanding (SLU) and Natural Language Processing (NLP) tasks are accomplished.

Fetching the Content to be displayed: The commands are mapped to specific functions which help in navigating through the notice board system. Once the commands are processed and interpreted from the user’s speech, the respective actions are taken according to the voice command received in order to give the desired output. Content is accessed from the web platform where all the notices and events are uploaded by the admin (authorised by admin login).

Displaying Content: Raspberry Pi connects the web platform and the notice board display over a wireless network. It enables the fetched content to be viewed on the display unit.

From the architecture diagram we can infer that the first step involves speaking the voice commands into the microphone which will enable us to interact with the system and the contents displayed on the board. Raspberry Pi’s USB support enables the microphone to be connected to the system.

These commands are then passed to the web platform through the Raspberry PI board that accesses the website over a wireless network (Ethernet or Wi-Fi).

Raspberry PI accesses the web platform over the internet. It has HDMI support which enables it to connect to the notice board screen on which the output is displayed. The display unit can be an LFD (Large Format Display) or any display with a HDMI port. This is the component that the user can see and interact with and the part of the system that facilitates the user experience, thus it is necessary to choose a display that is appropriate according to the requirements of the location where the system is set up and the number of viewers it is intended to cater to at any given time.

NLP enables the conversion of speech to text and the processing of those commands to display the appropriate output. Natural language processing is a subdivision of Artificial Intelligence that is widely used for creating assistants and for processing human speech. This technology works on the dialogue spoken by the user, breaks it down into tokens and processes it accordingly for proper understanding. Alan AI allows us to add conversational experience via robust and reliable AI assistants or chatbots to our application. The Alan AI backend takes care of most of the heavy lifting when it comes to speech processing. It is easy to integrate into and employ with react js web applications. The Alan AI button is visible at the bottom right

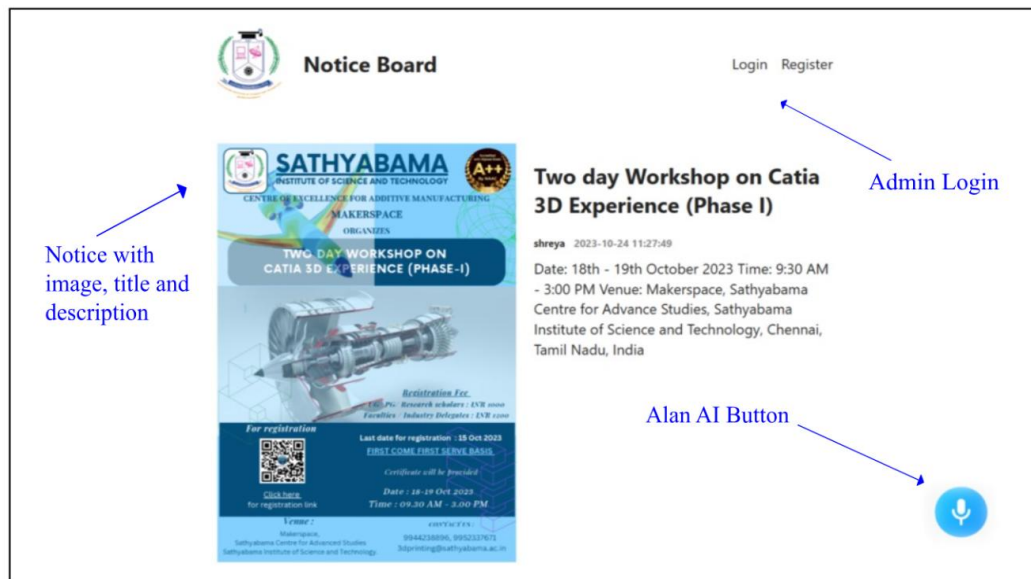


FIGURE 3. The home page of the web platform showing the admin login button, the Alan AI button at the bottom right corner, and a notice consisting of an image, the notice title and a short description about the same.

The web platform is used both to manage the content of the notice board as well as to display that content on the screen. The proposed system uses ReactJS to build the web platform. It helps build the functional front end of the website that the user interacts with. React is used to create modular user interfaces and it also involves the development of reusable UI components. ReactJS will be utilised to build the web platform for displaying the latest notices.

The web platform displays the notices in a format that involves a combination of both images and text. The notice format involves an image alongside a short description for the same, the author and the date and time the notice has been posted.

More detailed information on the same are available within each notice. The home page displays 20 of the most recently uploaded notices at a time, with the most recently uploaded post on the topmost position.

As seen in the use case diagram, the user can use commands like “scroll up” and “scroll down” to view the posts on the page. These commands help navigate and scroll through both the home page as well as the individual posts that the user would like to view.

The “view post” command can be used to select a particular post to view more details about it such as the date and time of the events, detailed description, registration links and contact numbers etc. The “go back” command helps navigate back to the homepage.

These voice commands can be used to interact with the notice board, and each command from the user triggers an acknowledgement from the notice board, which responds with speech. This informs the user that the command has been successfully captured by the voice assistant.

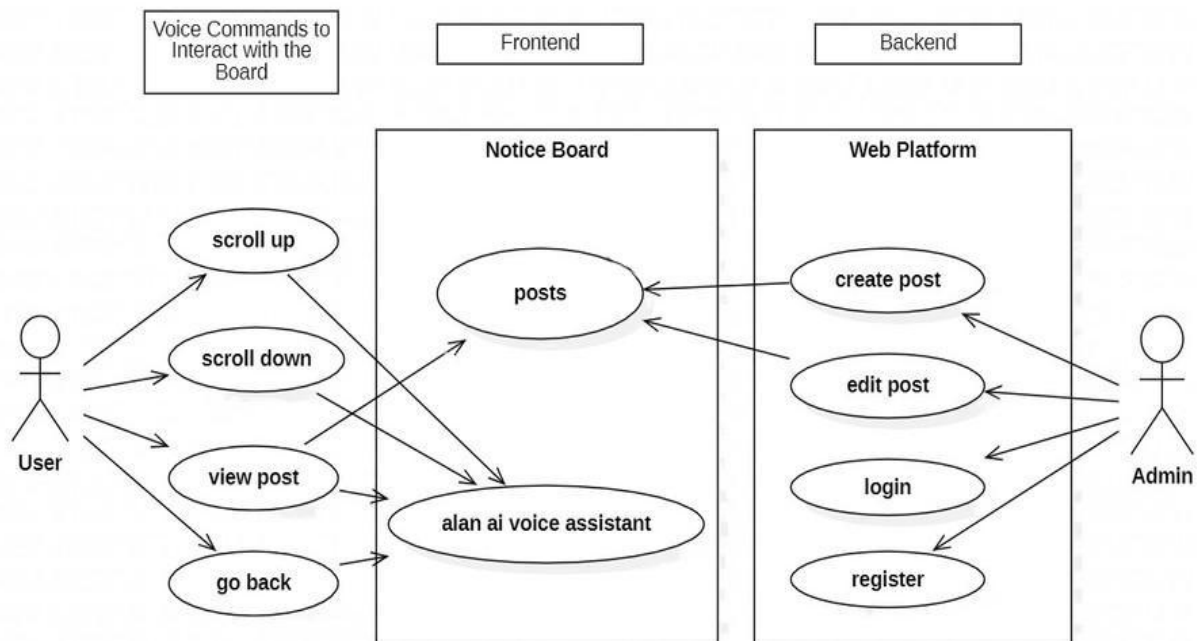


FIGURE 4. System use case diagram depicting the interaction with the system both from user side and client side

Registration allows us to create new admin login credentials, and logging in enables us to create new notices, or to edit pre-existing notices provided we are the authors of said notice.

All the created login credentials are stored in the database and the passwords are encrypted for safety. if the credentials already exist, then an alert message is triggered saying that registration is unsuccessful. However, if the registration is successfully completed, then an alert message notifies the same.

Creating a new post is possible only after login. On creation, the author’s name, upload date and time is displayed alongside the post.

Editing a post is possible only if you are the author of said post. Admins do not have access to edit posts that have been uploaded by other admins. All created posts are stored in the database along with the description details.

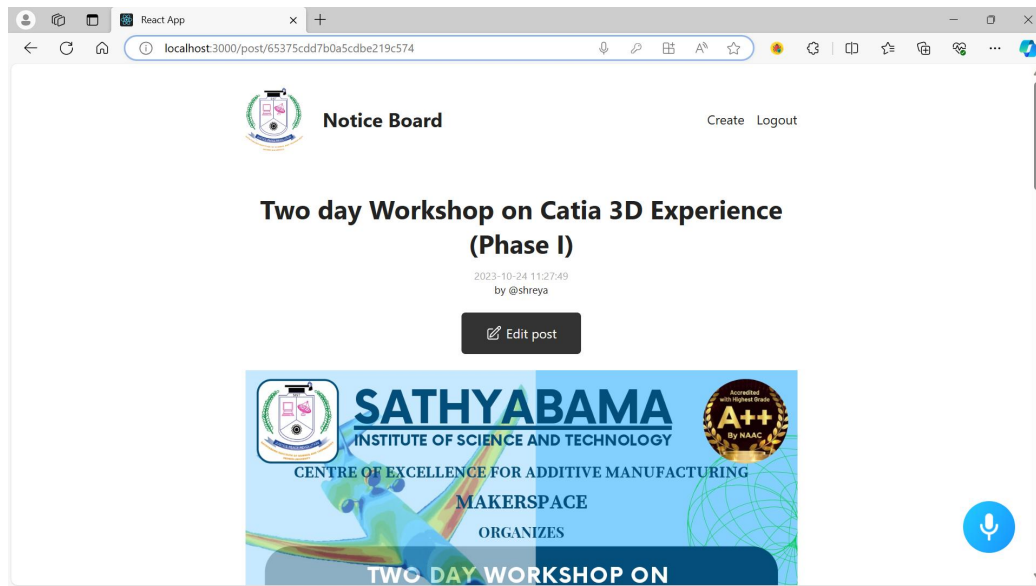
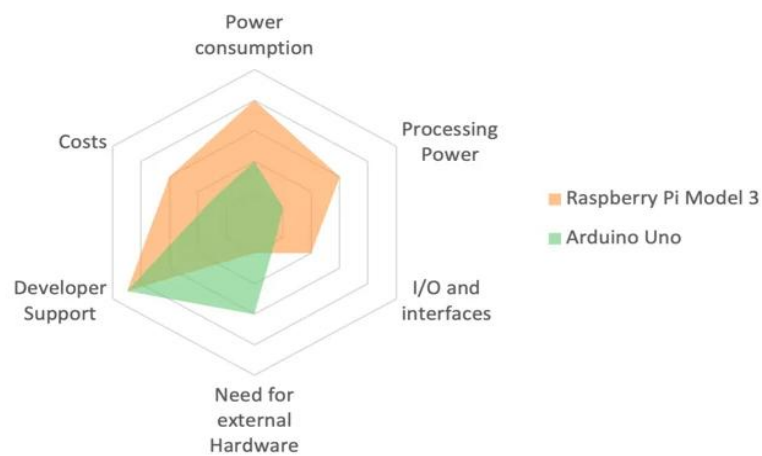


FIGURE 5. Post view displayed when a post is selected, along with the edit post option displayed only for the post author.



PERFORMANCE ANALYSIS

FIGURE 6. A chart comparing the performance capabilities of Arduino UNO and Raspberry Pi.

From the above chart we can deduce that Raspberry Pi has significantly higher processing power as compared to Arduino UNO which leads to a better system as compared to previous iterations. Raspberry Pi is suitable for running web servers and for performing more computationally demanding tasks as opposed to Arduino UNO which is tailored towards the performance of more simple tasks that do not demand complex computation or multitasking. Arduino UNO does not come with wireless communication support or built in networking facilities, but Raspberry Pi comes equipped with built-in connectivity options like Ethernet, Wi-Fi and Bluetooth etc. Peripheral devices like keyboards, mics and storage devices can also be connected via USB ports in Raspberry Pi. These features ensure higher flexibility and better suitability for a variety of use cases.

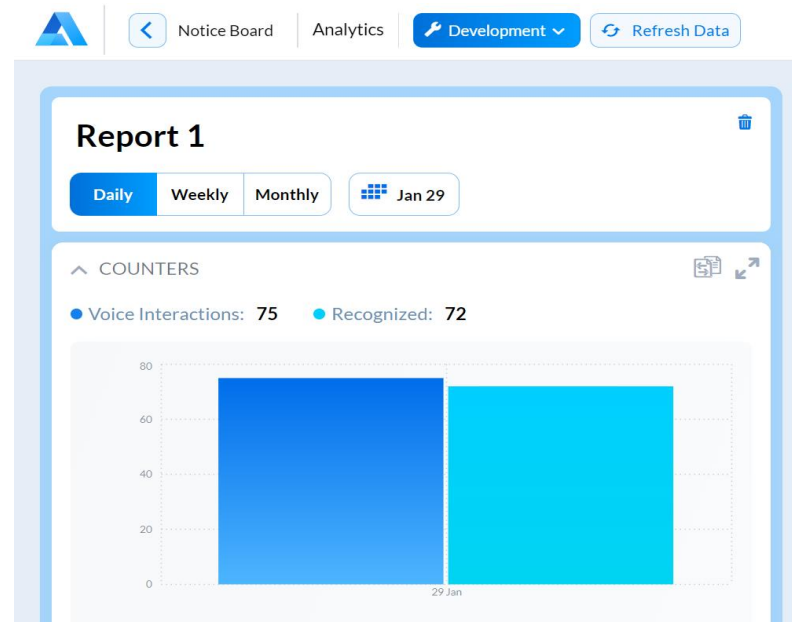
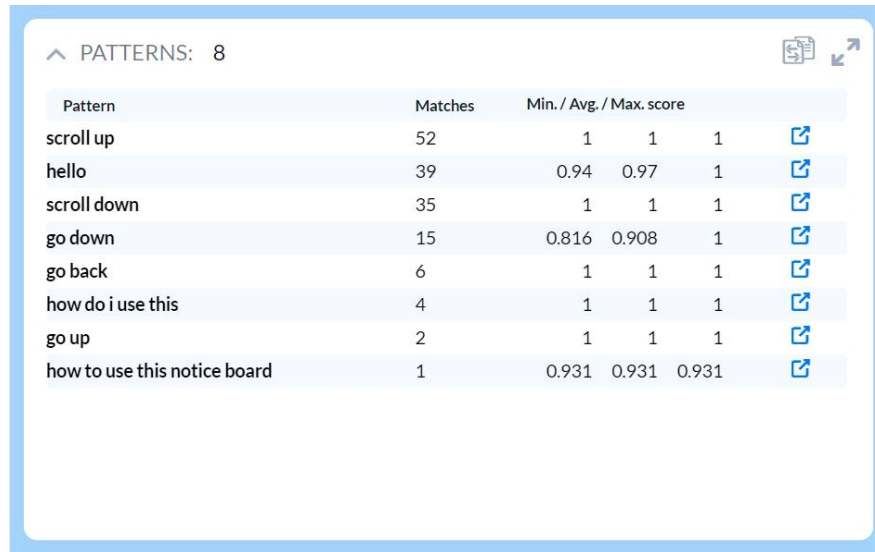


FIGURE 7. Alan AI Analytics depicting the total vs recognised voice interactions in the form of a bar graph for a given day when the system voice command capture accuracy was tested.

Alan AI provides the facility to review the voice interactions being made with the system on a daily, weekly or monthly basis. The analytics provisions provide plenty of metrics, such as recognized command counters, session counters (number of sessions, button clicks etc.), user locations, interactions (identified commands), patterns, pattern flow etc, all of which help us in the study and analysis of the performance of our voice command processing system. This recorded data can be used to derive meaningful insights regarding present performance as well as scope for future improvement.

In the graph above, we can see that voice interactions with our web platform voice assistant have been identified and recognised correctly 72 times out of 75, on a given day. This indicates a 96% speech-to-text conversion accuracy. This proves that Alan AI is highly efficient at capturing spoken commands and interpreting them as required.



Pattern	Matches	Min. / Avg. / Max. score
scroll up	52	1 1 1
hello	39	0.94 0.97 1
scroll down	35	1 1 1
go down	15	0.816 0.908 1
go back	6	1 1 1
how do i use this	4	1 1 1
go up	2	1 1 1
how to use this notice board	1	0.931 0.931 0.931

FIGURE 8. Patterns and their corresponding scores displayed in Alan AI Analytics.

When the user says anything, Alan AI matches the user's utterance to the most appropriate intent in the dialog script. To do this, Alan AI evaluates every intent separately and assigns different weights, or match scores, to intents. Match score values range from 1.0 (the most accurate match) to 0.0 no match. These observed patterns along with their scores are displayed in the patterns panel within analytics. This enables Alan AI to accurately recognise the meaning of commands even if they slightly differ from the actual mapped command while having the same intent.

CONCLUSION AND FUTURE ENHANCEMENTS

We have successfully come up with a digital notice board system that eliminates the laborious process of updating multiple notice boards in the organisation premises manually, as our system allows for simultaneous updation of all boards centrally.

We have managed to overcome observed drawbacks in existing systems such as the usage of GSM technology by making use of Wi-Fi networks which offer more reliable connections and faster speeds as compared to mobile networks, which are costlier and are dependent on tower range and other factors.

The conglomeration of images and text in the notice format makes for effective conveyance of information in an eye catching manner.

With improvements in AI and language models, various enhancements can be made to the voice assistant such as multiple language support, better language models leading to better comprehension of natural language.

The database management system can also be further improved if required by using new technologies like big data to handle larger sizes of data and multiple formats more efficiently and effectively

To further strengthen the security of the system along with regular password authentication we can restrict login access based on a range of authorised login IP addresses.

Adding more voice commands would enhance the interactivity and functionality to the system. This will enable the assistant to be able to comprehend and respond to a wider variety of possible inputs and provide the desirable responses and outputs.

REFERENCES

1. V. S. Kumar, S. Amirthasri, M. Ananya and S. Esther, "A Novel Method of IoT Based Smart Notice Board Using Raspberry PI," 2022 International Conference on Computer, Power and Communications (ICCCPC), Chennai, India, 2022, pp.60-64, doi: 10.1109/ICCCPC55978.2022.10072128.

2. Asmita Mahendrakumar Khairnar, Prof. S.S. Vaidya and Rashmi Kishor Kolambe. "Smart Digital Notice Board." *International Journal Of Advanced Research And Innovative Ideas In Education* 6, no. 1 (2020) : 1113-1120.
3. Y. Sravana kumar, D. Hima Varshini, D. Tilothama, D.Jagadeesh, and I. Jithendra, "Iot Based Smart Notice Board." *International Journal of Advances in Engineering and Management (IJAEM)* Volume 4, Issue 6 June 2022, pp: 633-637 ISSN: 2395-5252.
4. Pabale, Trupti, Shweta Borade, Bhagyashri Deore, Mohani Kharwar, and Deepika Thakare. "IOT Based Digital Notice Board." *Spvryan's International Journal of Engineering Sciences & Technology (SEST)* ISSN : 2394-0905
5. M. Phani Sridhar, Sk Ayesha, Tarun dev and Varanasi Sai Aseesh "Wireless Digital Notice Board Using IOT." *International Journal of Progressive Research in Engineering Management and Science (IJPREAMS)* Vol. 03, Issue 04, April 2023, pp: 568-571 e-ISSN : 2583-1062.
6. Rhutik Dhanawade, Abhishek Sasne, Vishal Patole, Bhawana Patil, Ajinkya Patil, "IOT based Digital Notice Board." *IJISSET - International Journal of Innovative Science, Engineering & Technology*, Vol. 10 Issue 01, January 2023 ISSN (Online) 2348 - 7968
7. Gaurav Bhardwaj, Gunjan Sahu, Rajan Kumar Mishra, "IOT based Smart Notice Board" *International Journal of Engineering Research & Technology (IJERT)* Vol. 9 Issue 06, June-2020 ISSN: 2278-0181.
8. Unmesh Mawalkar, Snehal Sardar, Harshada Varade, Prof. M. P.Giri "Wireless Electronics Notice Board" *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)* Volume 2, Issue 6, May 2022 ISSN (Online): 2581-9429
9. Vinay Sahu, Pallavi Ubnare, Priyanshu Patil, Priya Barhaiya, Shreyash Sinha, Rohit Dafare, "Conversational Voice Controlled React News Application Using Alan AI" (*IJIRMPS*) *International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences*, Volume 11, Issue 1, January-February 2023 e-ISSN: 2349-7300.
10. Aditya Sharma, Subiya Siddiqui, Sugandha Trivedi, Ali Murtaza, Mohd Faiez, Shyam Dwivedi, "Voice Controlled News Web Based Application With Speech Recognition Using Alan A.I." *International Research Journal of Engineering and Technology (IRJET)*, Volume: 09 Issue: 04, Apr 2022 e-ISSN: 2395-0056.
11. Bharath, M. et. al. "Design and Development of a Smart Mirror Based On IOT." *Turkish Journal of Computer and Mathematics Education (TURCOMAT)* 12, no. 12 (2021): 2641-2646.
12. Pandya, Ashutosh, Chinmay Raut, Mihir Patel, D. Das, and Amol Deshpande. "Bluetooth Based Electronic Notice Board." *International Journal of Engineering and Advanced Technology* 10, no. 1 (2020): 178-181.
13. A. Kumar, G. Singh, V. Rawat, D. Negi and A. Joshi, "Remotely Controlled Electronic Noticeboard Using NodeMCU," 2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT), Delhi, India, 2023, pp. 1-6, doi: 10.1109/ICCCNT56998.2023.10306793.
14. S. Malodia, N. Islam, P. Kaur and A. Dhir, "Why Do People Use Artificial Intelligence (AI)-Enabled Voice Assistants?," in *IEEE Transactions on Engineering Management*, vol. 71, pp. 491-505, 2024, doi: 10.1109/TEM.2021.3117884.
15. Karlekar, Gaurav S., Prachi V. Dhamange, Pallavi S. Duratkar, Shrushti S. Vaidya, Ankita R. Zilpe, and Simran S. Gujar. "BLUETOOTH BASED DIGITAL NOTICE BOARD WITH SOLAR." *International Research Journal of Engineering and Technology (IRJET)*, Volume: 07 Issue: 03 , Mar 2020 e-ISSN: 2395-0056.

D. CERTIFICATE

